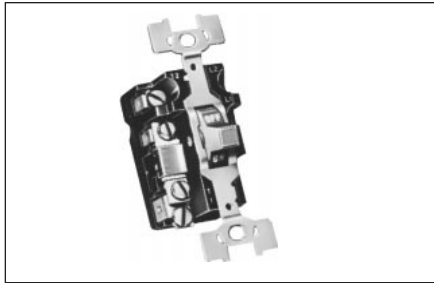


AC Controls

Manual Starters and Switches



Type F02

Class SMF

Class SMF fractional horsepower starters provide overload protection as well as manual ON / OFF control for small motors in a variety of industrial and commercial installations.

Available in one or two pole versions, these devices are suitable for use with AC single phase motors to 1 HP. Two pole starters can also be used with DC motors to 3/4 HP. Typical applications include fans, conveyors, pumps, and small machine tools. The continuous current rating is 16 amperes.

Overload trip assembly motor protection is provided by a Type SMFH thermal heater element which must be installed before the starter will operate.

Two-Speed Class SMF manual starters are designed for control of small single phase AC motors having separate windings for high and low speed operation. Two toggle operated starters are used, with overload protection included for each motor winding. Surface mounting devices, and those with a gray flush plate, utilize a mechanical interlock which allows direct control of the motor by means of the toggle operators.

Class MMS and MRS

These motor starting switches provide manual ON / OFF control of single or three-phase AC motors, where overload protection is not required, or is provided separately.

These devices are suitable for use with AC three-phase motors up to 10 HP. Compact construction and a 600 volt rating make these switches suitable for a wide range of industrial and commercial uses. Typical applications include small machine tools, pumps, fans, conveyors, and many other types of electrical machinery. They can also be used on non-motor loads such as resistance heaters.

The continuous current rating is 30 amperes at 250 volts max., 26.4 amperes at 277 volts max., 20 amperes at 600 volts max, 30 ampere resistive at 600 volts max.

Class MMS, two-speed manual switches may be used with separate winding, three-phase or single-phase AC motors where overload protection is not required, or is provided separately. Two switches are employed to give ON / OFF control in each speed.

Class MRS, reversing manual switches provide a compact means of starting, stopping and reversing AC motors where overload protection is not required, or is provided separately. They are suitable for use with three-phase squirrel cage motors, and for single-phase motors which can be reversed by reconnecting motor leads. Two switches are used, one to connect the motor for forward rotation, and one for reverse.

Class SMF, MMS and MRS

NEMA Type 1 surface mounting enclosures are sheet steel with a thermoplastic wrap-around cover for convenience in wiring. The NEMA Type 1 enclosure is also available in oversized and jumbo



Type K02

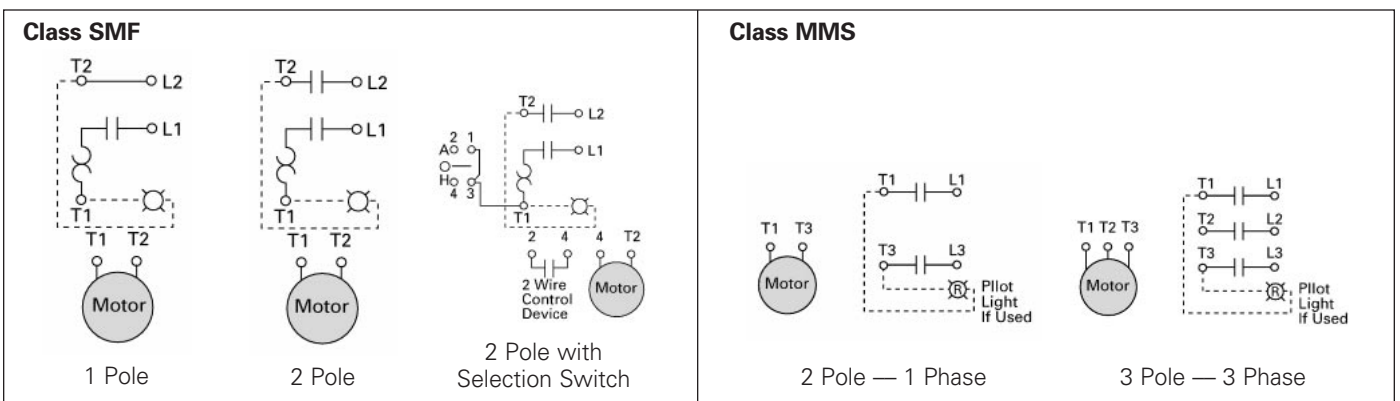
versions allowing more wiring space. A zinc alloy die casting or non-metallic enclosure is used for NEMA Type 4 enclosures. NEMA 7 & 9 enclosures are supplied as standard with provisions for locking in the ON or OFF position.

Standard red or non-standard green neon pilot light units are available factory installed in NEMA Type 1 surface and flush mounting, and NEMA Type 4 enclosures, or as a field modification kit for NEMA Type 1 enclosures and gray flush plates.

An "Emergency-OFF" toggle operator extender is available for NEMA Type 1 surface mounted units. The extender has a red vinyl button that provides a fast and easy method for locating and switching the device's toggle operator into the OFF position. The Emergency OFF Actuator is available in kit form only for field installation.

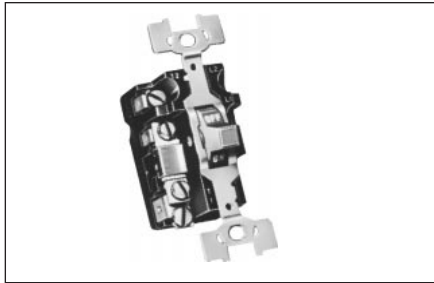
An optional Handle Guard / Lock-OFF on NEMA Type 1 enclosed starters prevents accidental operation of the toggle and also allows the toggle operator to be padlocked in either the ON or the OFF position. This handle guard can be factory installed on NEMA Type 1 enclosed starters and is also available in kit form for field installation on NEMA Type 1 surface and flush mounting enclosures. Standard NEMA Type 4 metallic enclosures include provision for padlocking in the OFF position.

Typical Wiring Diagrams



AC Controls

Manual Starters and Switches



Type F02

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Class SMF, MMS and MRS

NEMA Type 1 surface mounting enclosures are sheet steel with a thermoplastic wrap-around cover for convenience in wiring. The NEMA Type 1 enclosure is also available in oversized and jumbo



Type K02

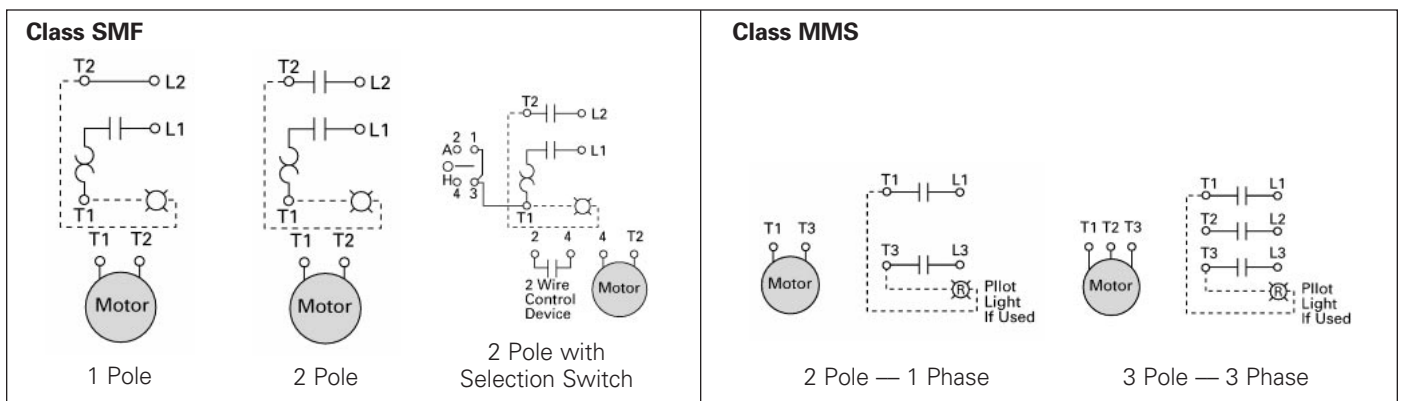
versions allowing more wiring space. A zinc alloy die casting or non-metallic enclosure is used for NEMA Type 4 enclosures. NEMA 7 & 9 enclosures are supplied as standard with provisions for locking in the ON or OFF position.

Standard red or non-standard green neon pilot light units are available factory installed in NEMA Type 1 surface and flush mounting, and NEMA Type 4 enclosures, or as a field modification kit for NEMA Type 1 enclosures and gray flush plates.

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An optional Handle Guard / Lock-OFF on NEMA Type 1 enclosed starters prevents accidental operation of the toggle and also allows the toggle operator to be padlocked in either the ON or the OFF position. This handle guard can be factory installed on NEMA Type 1 enclosed starters and is also available in kit form for field installation on NEMA Type 1 surface and flush mounting enclosures. Standard NEMA Type 4 metallic enclosures include provision for padlocking in the OFF position.

Typical Wiring Diagrams



AC Controls

Manual Starters and Switches

General

Table 15.1 Horsepower Ratings

Voltage	Maximum Horsepower		
	AC Single Phase		DC 2-Pole Only
	1-Pole	2-Pole	
115–230	1	1	¾
277	1	1	—

Table 15.2 Horsepower Ratings

Device	Number of Poles	Motor Type AC	AC Ratings			DC Ratings		
			115 Volts	230 Volts	460–575 Volts	90 Volts	115 Volts	230 Volts
Class MMS	2	Single Phase	2	2	3	1	2	1½
	3	Three Phase	2	7½	10	1	2	1½
Class MRS	2	Single Phase	2	2	3	1	2	1½
	3	Three Phase	2	7½	10	1	2	1½
Class MMS Two Speed	2	Single Phase	2	2	3	1	2	1½
	3	3 Phase, Constant or Var. Torque	2	7½	10	1	2	1½
	3	3 Phase, Constant HP	2	7½	10	1	2	1

Table 15.3 Manual Starters and Switches Features

Class SMF Fractional Horsepower Manual Starters with Melting Alloy Type Thermal Overload Relay, Single Unit Types			Class MRS and MMS Manual Switches			
Type of Operator	No. of Poles	Features	Type of Operator	No. of Poles	Features	
Basic Starter			Class MMS — Non-Reversing			
Toggle	1	Standard With Red Pilot Light	Toggle	1	Standard With Pilot Light (115 and 230 VAC)	
	2			2	Standard With Pilot Light (205–240 and 440–600 VAC)	
Key	1		Key	1	Standard With Pilot Light (115 and 230 VAC)	
	2			2	Standard With Pilot Light (208–240 and 440–600 VAC)	
Starter With Handle Guard / Lock-Off			Class MMS — Reversing			
Toggle	1	Standard With Red Pilot Light	Type of Operator	No. of Poles	Suitable for Motor Types	Features (Incl. Mechanical Interlock)
	2		Toggle	2	Single-Phase Two-Winding (3-Lead)	Std. With Pilot Light (115 and 230 VAC)
	1			3	3-Phase and 1-Phase Capacitor, Split-Phase 4-Lead Repul.-Induct.	Std. With Pilot Light (110–120, 208–220, 440–600 VAC)
	2		Class MMS — Two-Speed			
One Starter In Duplex Enclosure			Toggle	2	Single-Phase Two-Winding (3-Lead)	Std. With 2 Pilot Lights (115 and 230 VAC)
Toggle	2	Standard With Red Pilot Light		3	Three-Phase Separate Winding (Wye-Connected)	Std. With 2 Pilot Lights (208–220, and 440–600 VAC)
Key	2		Class MMS — Two-Speed			
Two Starters In One Enclosure			Toggle	2	Single-Phase Two-Winding (3-Lead)	Std. With 2 Pilot Lights (115 and 230 VAC)
Toggle	2 Each Str.	Standard With Red Pilot Light On Each		3	Three-Phase Separate Winding (Wye-Connected)	Std. With 2 Pilot Lights (208–220, and 440–600 VAC)
Key	2		Class MMS — Two-Speed			
Starter and "Auto-Off-Hand" SPDT Selector Switch (AC Only)			Toggle	2	Single-Phase Two-Winding (3-Lead)	Std. With 2 Pilot Lights (115 and 230 VAC)
Toggle	1	Standard With Red Pilot Light		3	Three-Phase Separate Winding (Wye-Connected)	Std. With 2 Pilot Lights (208–220, and 440–600 VAC)
Key	2		Class MMS — Two-Speed			
Two-Speed Starters (AC Only)			Toggle	2	Single-Phase Two-Winding (3-Lead)	Std. With 2 Pilot Lights (115 and 230 VAC)
Toggle	1	With Mechanical Interlock (Standard With 2 Red Pilot Lights)		3	Three-Phase Separate Winding (Wye-Connected)	Std. With 2 Pilot Lights (208–220, and 440–600 VAC)
Toggle	2	With High-Off-Low Selector Switch (With 2 Red Pilot Lights)	Class MMS — Two-Speed			

Table 15.4 Class SMF Heater Elements

Motor Full-Load Current (Amperes)	Heater Cat. No.	Motor Full-Load Current (Amperes)	Heater Cat. No.	Motor Full-Load Current (Amperes)	Heater Cat. No.	Motor Full-Load Current (Amperes)	Heater Cat. No.
0.157–0.173	SMF H01	0.59–0.65	SMF H014	1.80–1.99	SMF H027	5.86–6.41	SMF H40
0.174–0.192	SMF H02	0.66–0.71	SMF H015	1.96–2.15	SMF H028	6.42–6.79	SMF H41
0.193–0.212	SMF H03	0.72–0.78	SMF H016	2.16–2.38	SMF H029	6.80–7.57	SMF H42
0.213–0.235	SMF H04	0.79–0.85	SMF H017	2.39–2.75	SMF H030	7.58–8.15	SMF H43
0.236–0.261	SMF H05	0.86–0.96	SMF H018	2.76–2.84	SMF H031	8.16–8.98	SMF H44
0.262–0.289	SMF H06	0.97–1.04	SMF H019	2.85–3.06	SMF H032	8.99–9.67	SMF H45
0.290–0.321	SMF H07	1.05–1.16	SMF H020	3.07–3.45	SMF H033	9.68–9.95	SMF H46
0.322–0.355	SMF H08	1.17–1.25	SMF H021	3.46–3.70	SMF H034	9.96–10.8	SMF H47
0.356–0.399	SMF H09	1.30–1.39	SMF H022	3.71–4.07	SMF H035	10.9–12.1	SMF H48
0.40–0.44	SMF H010	1.38–1.54	SMF H023	4.08–4.32	SMF H036	12.2–13.1	SMF H49
0.45–0.49	SMF H011	1.48–1.63	SMF H024	4.33–4.90	SMF H037	13.2–13.9	SMF H50
0.50–0.53	SMF H012	1.57–1.75	SMF H025	4.91–5.35	SMF H038	14.0–15.0	SMF H51
0.54–0.58	SMF H013	1.66–1.86	SMF H026	5.36–5.85	SMF H039	15.1–16.0	SMF H52

15

AC Controls

AC Controls

Manual Starters and Switches

Table 15.5 General Purpose Flush Mounting

Device	Type of Operator	Type	Dimensions in Inches (mm)		
			A	B	C
Class SMF Fractional HP Starter	Toggle	FF1, 1P, 2, 2P	1.44 (37)	2.75 (70)	4.50 (114)
		FS1, 1P, 2, 2P	1.44 (37)	3.50 (89)	5.25 (133)
		FSJ1P, 2P	1.44 (37)	3.50 (89)	5.25 (133)
	Key	FF3, 3P, 4, 4P	1.44 (37)	2.75 (70)	4.50 (114)
		FS3, 3P, 4, 4P	1.44 (37)	2.75 (70)	4.50 (114)
		FSJ3P, 4P	1.44 (37)	3.50 (89)	5.25 (133)
Class MMS Motor Starting Switch	Toggle	KF1, 1A, 1B, 2, 2B, 2C	1.75 (44)	2.75 (70)	4.50 (114)
		FS1, 1A, 1B, 2, 2B, 2C	1.75 (44)	2.75 (70)	4.50 (114)
		KSJ1A, 1B, 2B, 2C	1.75 (44)	3.50 (89)	5.25 (133)
	Key	KF3, 3A, 3B, 4, 4B, 4C	1.75 (44)	2.75 (70)	4.50 (114)
		FS3, 3A, 3B, 4, 4B, 4C	1.75 (44)	2.75 (70)	4.50 (114)
		KSJ3A, 3B, 4C, 4C	1.75 (44)	3.50 (89)	5.25 (133)

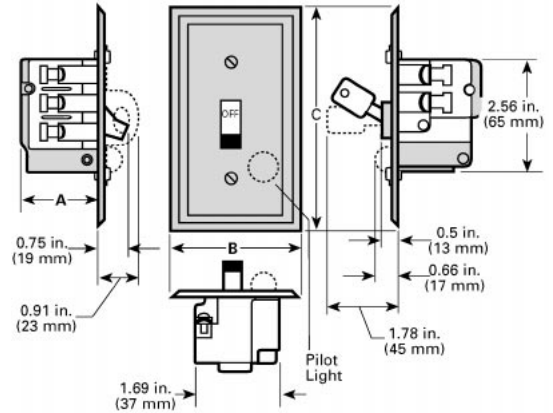


Table 15.6 Two Unit Devices NEMA Type 1 General Purpose Enclosure

Device	Type of Operator	Class	Type
One Starter	Toggle	SMF	FG02, 02P
	Key	SMF	FG04P
Two Starters	Toggle	SMF	FG222, 222P
	Key	SMF	FG44P
One Str. and One Sel. Sw. ①	Toggle	SMF	FG71, 71P, 72, 72P
	Key	SMF	FG74P
Reversing Switch ②	Toggle	MRS	KG11, 11A, 11B, 22, 22A, 22B, 22C
Two Speed Starter	Toggle	SMF	FG11, 11P, 22, 22P
Two Speed Switch	Toggle	MMS	KG11, 11A, 11B, 22, 22B, 22C

① Selector switch is on left, increases overall depth to 3.5 in. (89mm)
 ② Only one pilot light (located on right) is used on MRS switches.

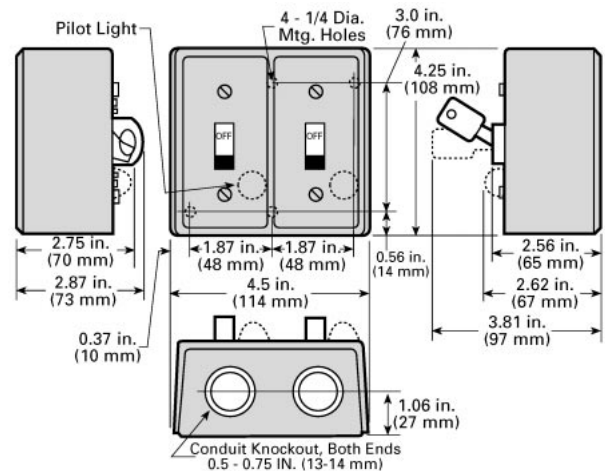
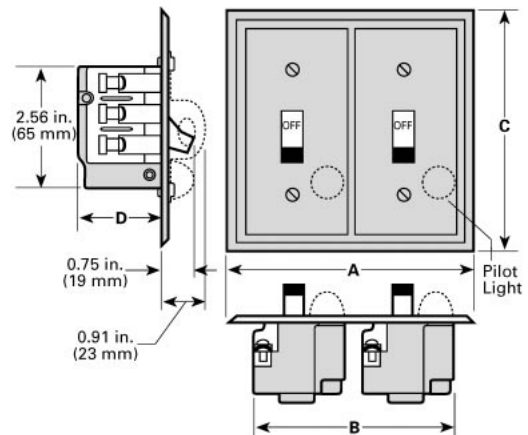


Table 15.7 General Purpose Flush Mounting for Two Unit Devices

Device	Type of Operator	Class	Type	Dimensions in Inches (mm)			
				A	B	C	D
Two Starters	Toggle	SMF	FF22, 22P	5.25 (133)	3.75 (95)	5.25 (133)	1.44 (37)
			FS22P	4.56 (116)	3.50 (89)	4.50 (114)	1.44 (37)
	Key	SMF	FF44P	5.25 (133)	3.75 (95)	5.25 (133)	1.44 (37)
			FS44P	4.56 (116)	3.50 (89)	4.50 (114)	1.44 (37)
One Starter and One Selector Switch ③	Toggle	SMF	FF71, 71P, 72, 72P	5.25 (133)	0.75 (19)	5.25 (133)	2.00 (51)
			FS71P, 72P	4.56 (116)	3.50 (89)	4.50 (114)	2.00 (51)
	Key	SMF	FF74P	5.25 (133)	3.75 (95)	5.25 (133)	2.00 (51)
			FS74P	4.56 (116)	3.50 (89)	4.50 (114)	2.00 (51)
Reversing Switch	Toggle	MRS	KF11, 11A, 11B, KF 22, 22A, 22B, 22C	5.25 (133)	3.75 (95)	5.25 (133)	1.75 (44)
Two Speed Starter	Toggle	SMF	FF11, 11P, 22, 22P	5.25 (133)	3.75 (95)	5.25 (133)	1.44 (37)
Two Speed Switch	Toggle	MMS	KF11, 11A, 11B, 22, 22B, 22C	5.25 (133)	3.75 (95)	5.25 (133)	1.75 (44)

③ Selector switch is on left, extends 1.62 in (41 mm) from mounting surface.



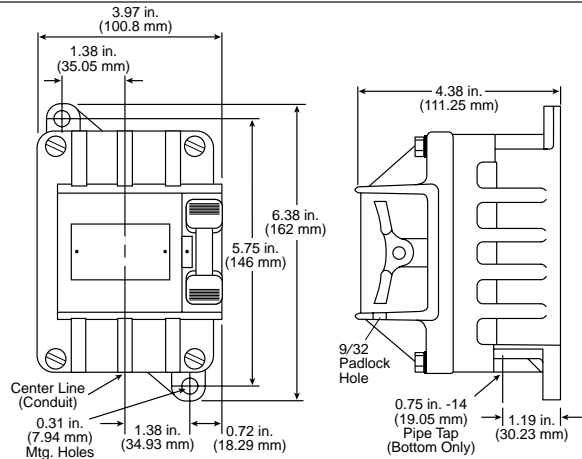
AC Controls

Manual Motor Starter Switches

Dimension / Wiring Diagrams

Table 15.8 Explosion Proof NEMA 7 & 9 Enclosures

Device	Type of Operator	Type
Class SMF Fractional HP Starter	Toggle	FR2, FR2H FR1, FR1H
Class MMF Motor Starter Switch	Toggle	KR2, KR2H KR2, KR1H



Application

Class 12 manual starting switches are designed to economically start and stop inherently protected single and polyphase motors as used in light machine tools, pumps, blowers, and vent-fans. They are also used as ON and OFF switches for resistive loads such as heating.

Features

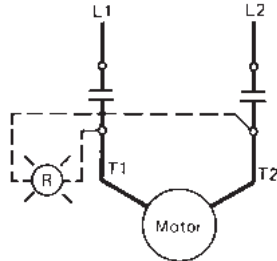
This switch is compact, economical, and easily wired using pressure type screw connectors. A rugged over center toggle mechanism results in a long life with weld free operation. It is available for surface mounting in a NEMA 1 enclosure, for flush mounting on a standard depth switch box or in custom panels. A pilot light for 120, 208 / 240, or 480 volts may

be added at any time before or after installation.

Table 15.9 Class 12 Manual Starting Switches

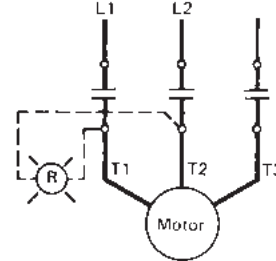
Type	Maximum Horsepower			
	115 Volts	230-575 Volts	120V DC	Continuous Amp Rating
1-Phase	2	3	1	24
3-Phase	—	2	—	15

Wiring Diagrams



1-Phase

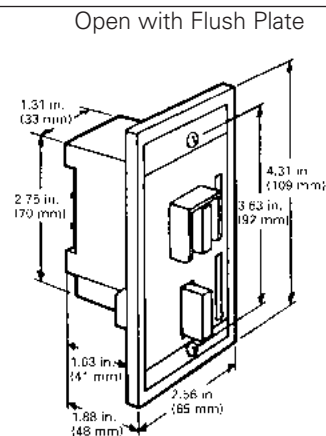
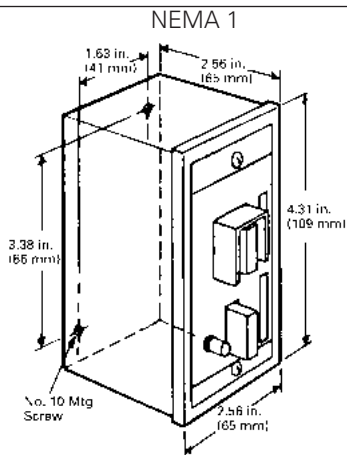
with 12ZAL* Pilot Light



3-Phase

with 12ZAL* Pilot Light

Dimension Drawings



AC Controls

Manual Motor Starter Protector



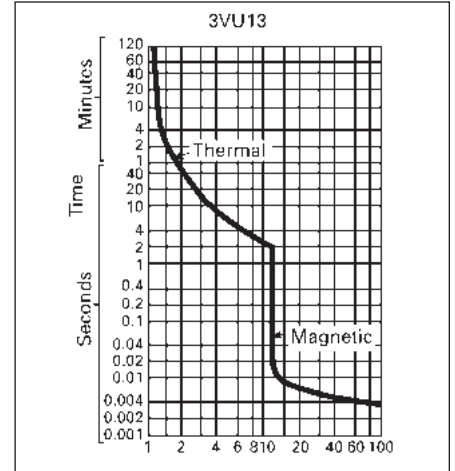
Type 3VU13 Manual Motor Starter Protector

Siemens 3VU13 is a 3-phase manual starter providing adjustable overload protection, optional field installed undervoltage protection, and short circuit protection.

Features

- Built-in Short Circuit Protection. Short circuit protection provided by the usual branch circuit protection device feeding a manual starter (fuse or circuit breaker in accordance with NEC 430-52) may not protect a common manual starter. The factory built-in instantaneous trip of the Motor Starter Protector will protect the starter as well as the cable and motor during low level faults.

- The Manual Starters Meet or Exceed Requirements of NEMA, EEMAC, UL, CSA, IEC, VDE and Other International Standards. The built-in instantaneous magnetic trip (similar to a circuit breaker with arc chamber) provides self protection against low-level short circuits.
- Motor Ratings — Up to 25 HP 3-Phase and 10 HP Single Phase.
- Class 10 Adjustable Ambient Compensated Overload Protection.
- Phase Loss Sensitivity.
- Undervoltage Protection — UV trip module may be added in field.
- Shunt Trip Module is also field addable.
- Available in Open Styles, NEMA 1 and 3R, watertight, dusttight, under table, and flush mount enclosures.
- 1 NO and 1 NC Auxiliary Contacts Standard.
- Group Installation - UL 508. The 3VU13 is suitable for Group Installation at 5kA 600 volts maximum with any fuse up to 1200 amperes or any inverse time circuit breaker up to 1200 amperes. The 3VU13 can be installed with or without Siemens contactors type 3TF2 or 3TF30 to 3TF34 in series. For higher interrupting ratings, consult Siemens.

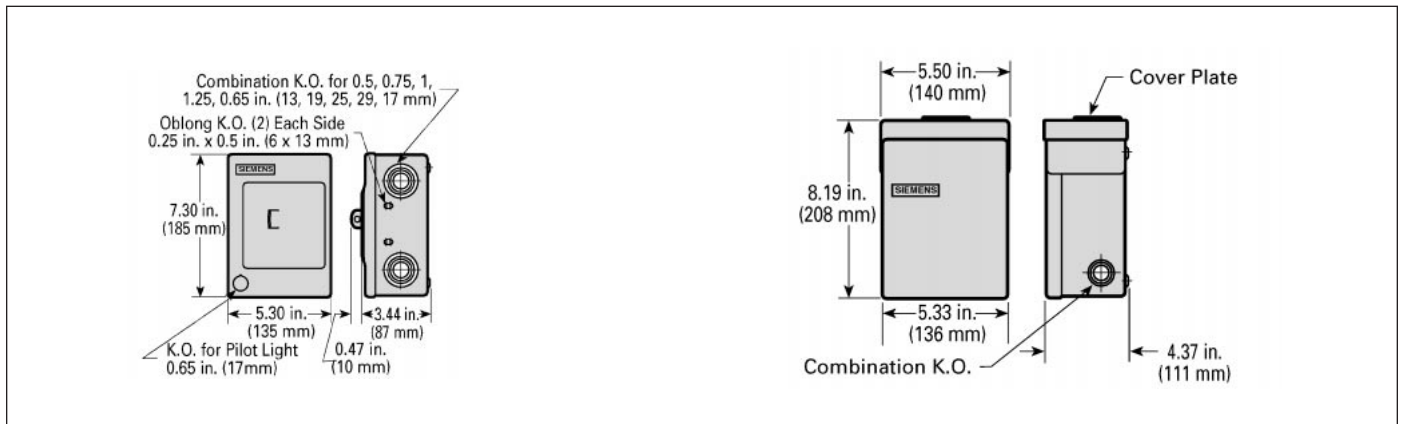


Overload and Magnetic Trip Tripping Characteristics

Table 15.10 Technical Data

Manual Motor Starter Protector	
Type	3VU13
Maximum Rated Continuous Current (Amperes)	25
Rated Operating Voltage AC	600V
— Power Circuit	
— Control Circuit	
Ambient Temperature Compensation °C	-20 +55
Maximum Rated HP of 3-phase Motors At:	
— AC 200V	5
— AC 240V	7½
— AC 460V	15
— AC 575V	20

3VU13 Enclosure Dimensions



AC Controls

Manual Motor Starters and Contactors

Application

Across the line manual motor starters and contactors provide control for machinery where start stop remote control is not required (optional remote stop control is available). Class 11 manual starters are used for single and polyphase motors up to 10 Hp. Starters have melting alloy overload relays which help protect against damage due to excessive current caused by a sustained overload, low line voltage, or single phasing of the motor.

Contactors provide control for inherently protected motors. Typical applications include metal and wood-working machinery, grinders, power saws, conveyors, fans pumps, blowers, textile and packaging machinery, slitters, and paper cutters.

Features

Class 11 manual controllers have front accessible pressure type wire connectors. Ample wiring space is provided for easy wiring.

A complete line of general purpose and industrial duty enclosures is available as well as open type mounting for custom built enclosures. These manual controllers are available with low voltage protection which will automatically open the power poles when the voltage drops or the power is interrupted. A remote stop function may be incorporated with the low voltage protection coil as a factory option to provide remote or semi-automatic operation.

Class 11 controllers provide the OSHA requirements for protecting personnel from potential injury caused by the automatic start up of machinery following a voltage drop or power interruption when low voltage protection is specified.

Open styles and devices in NEMA 1, 4, 7 & 9, 12 enclosures can be padlocked in the OFF position.

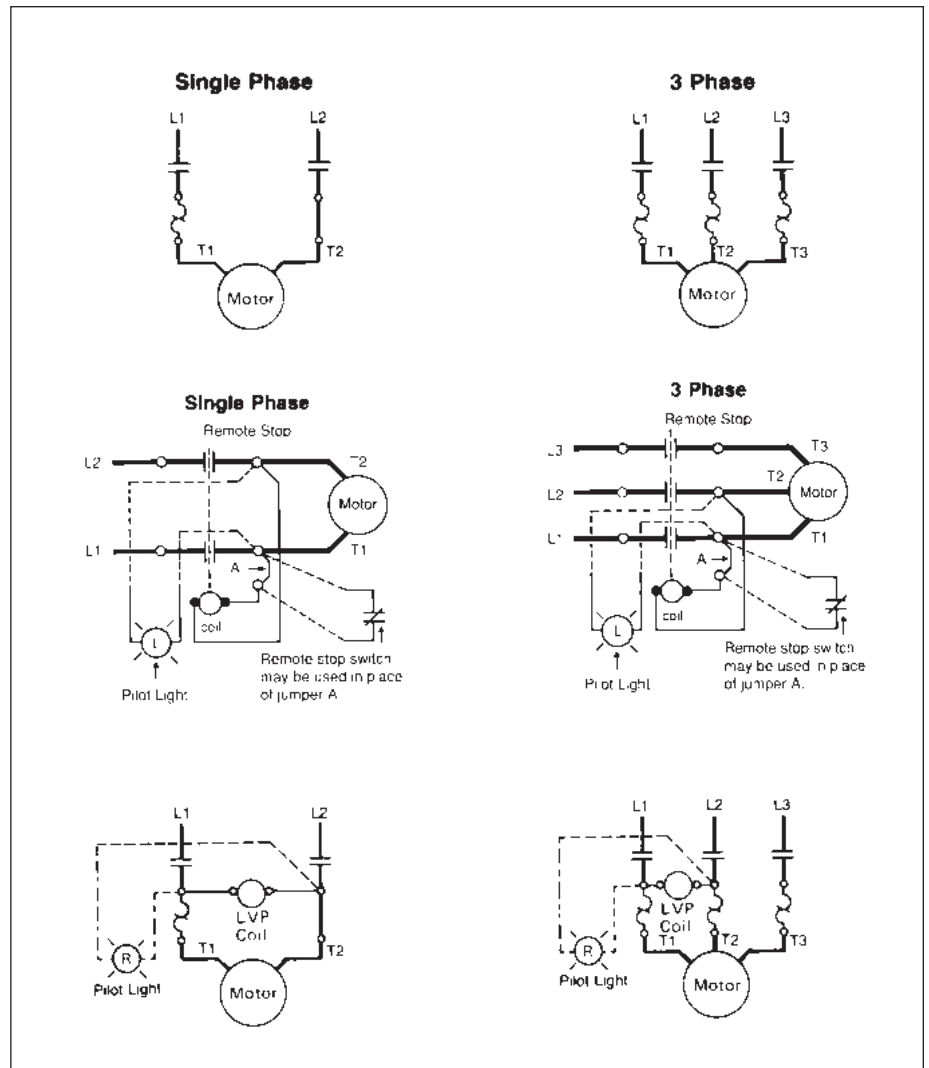


Table 15.11
Class 11 Manual Motor Starters

Type	Size	Maximum Horsepower	
		115 Volts	200/230 Volts
1-Phase	M0	1	2
	M1	2	3
	M1P	3	5
Type	Size	200/230 Volts	460/575 Volts
3-Phase	M0	3	5
	M1	7½	10

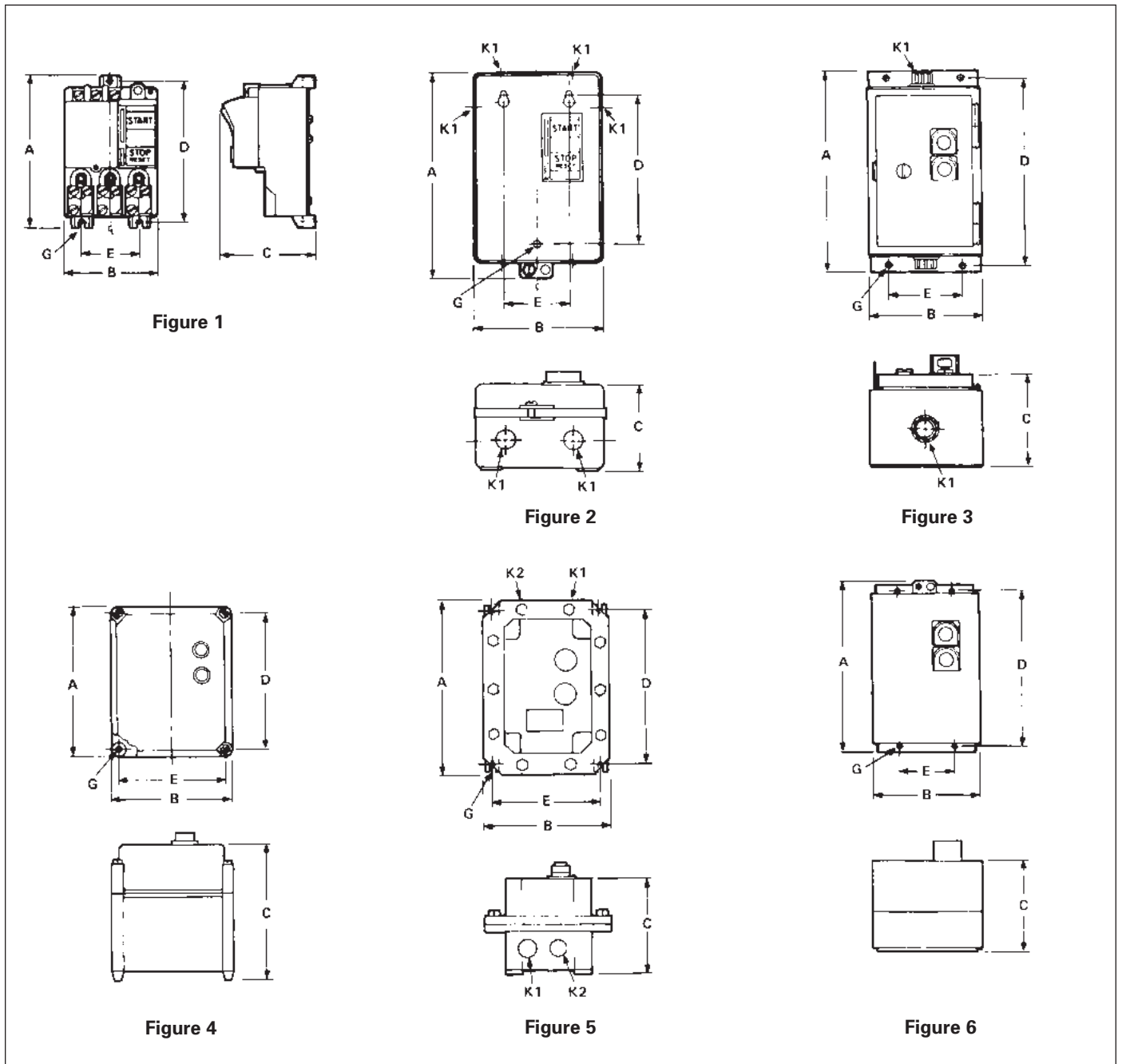
AC Controls

Manual Motor Starters and Contactors

Dimensions

Table 15.12 Motor Starters

Enclosure Type	Fig	Outline Dimensions in Inches (mm)			Mounting Dimensions in Inches (mm)		Mtg. Screw	Conduit Size		Max Wire Size	Approx Ship Wt Lbs	Ref Dwg
		A	B	C	D	E		K1	K2			
Open	1	5.313 (134.94)	2.500 (63.50)	3.625 (92.08)	5.500 (139.70)	2.250 (57.15)	10	—	—	8	3	D54755
NEMA 1	2	8.000 (203.20)	5.688 (114.46)	3.188 (80.96)	5.875 (149.23)	2.500 (63.50)	10	1/2-3/4	—	8	8	D25055
NEMA 4	3	11.875 (301.63)	6.250 (158.75)	5.125 (130.18)	10.375 (263.53)	4.125 (104.78)	1/4	—	—	8	10	D54824
NEMA 4X	4	11.875 (301.63)	7.938 (201.62)	7.313 (185.74)	11.125 (282.58)	6.875 (174.63)	10	1	—	8	12	D26243
NEMA 7 & 9	5	11.000 (279.40)	7.125 (184.15)	5.875 (149.23)	9.188 (233.36)	6.063 (153.99)	1/2	1/2	3/4	8	27	D56049
NEMA 12	6	9.700 (233.36)	5.875 (149.23)	5.063 (128.59)	8.625 (219.08)	3.000 (76.20)	—	—	—	8	11	D25293



AC Controls

Magnetic Contactors

General

Applications

Class 40 industrial magnetic contactors are designed for electrical loads such as heating, lighting, transformer and capacitor switching, and AC motor starting. They control motors already protected by inherent or other types of overload devices. Used with appropriate pilot control, a contactor provides a choice of undervoltage protection or release.

Class 40 contactors Size 0 thru 6 feature carefully wound coils encapsulated to seal out moisture. Encapsulation also promotes heat transfer and resists electrical, mechanical, and thermal stresses.

Features

Horsepower rated contactors are available in NEMA sizes 00 through 6, plus four Siemens Furnas Half Sizes: 1 $\frac{3}{4}$, 2 $\frac{1}{2}$, 3 $\frac{1}{2}$, and 4 $\frac{1}{2}$. These contactors are available as an open type or in NEMA 1, 3, 4, 4X, 7 & 9, or 12 enclosures. These contactors can also be used on capacitor and transformer switching applications.

Resistance heating contactors are available in 11 sizes from 10 through 350 amperes in 2- and 3-pole models and in 4 sizes in 4-pole models.

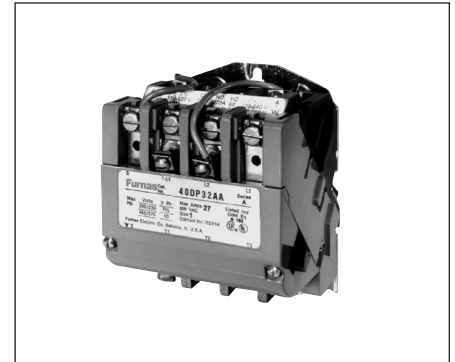
Lighting contactors are available in 11 sizes from 20 through 600 amperes in 2- and 3-pole models and in 3 sizes in 4-pole models. Lighting contactors are especially designed to switch ballast type, tungsten, and other discharge type lighting loads. These contactors may be controlled by timers and other pilot devices.

These contactors are also available with a DC coil and rectifier for reduction of AC hum in noise-sensitive areas such as hospitals, schools, and similar locations.

For information and availability of mechanically held lighting contactors, contact your local sales office.



Compact Lighting Contactor



Size 0-1 $\frac{3}{4}$

Table 15.13 Coil Data

Class Size	Watts	Volts 60Hz	Inrush (Open Magnet)		Normal (Sealed Magnet)	
			Amps	VA	Amps	VA
00	13.3	24	2.63	70	0.37	10
		120	0.59		0.08	
		208	0.34		0.05	
		240	0.305		0.045	
		277	0.25		0.03	
		480	1.49		0.02	
		600	0.121		0.02	
0 thru 2 $\frac{1}{2}$	8.6	24	9.08	218	1.04	25
		120	1.82		0.21	
		208	1.05		0.12	
		240	0.91		0.105	
		277	0.79		0.090	
		480	0.45		0.052	
		600	0.36		0.042	
3, 3 $\frac{1}{2}$	14	24	12.90	310	1.08	26
		120	2.58		0.217	
		208	1.49		0.125	
		240	1.29		0.108	
		277	1.12		0.094	
		480	0.646		0.054	
		600	0.516		0.043	
4	22	120	4.25	510	0.425	51
		208	2.45		0.245	
		240	2.14		0.215	
		277	1.77		0.183	
		480	1.08		0.112	
		600	0.85		0.085	
4 $\frac{1}{2}$, 5	63	120	12.65	1518	0.96	116
		240	6.32		0.48	
		480	3.16		0.24	
		600	2.53		0.193	
6	40	240	1.45	350	0.25	60
		480	0.73		0.12	
		600	0.58		0.10	

Table 15.14 Reference Literature

Instruction Sheets and Replacement Parts			
NEMA Size	Motor Matched Half Size	Instruction Sheet	Replacement Parts
00	—	PM-60.1	14-GBG
0-1	1 $\frac{3}{4}$	PM-60.1	14-GEP
2	2 $\frac{1}{2}$	PM-60.1	14-GFP
3	3 $\frac{1}{2}$	PM-60.1	14-GHP
4	4 $\frac{1}{2}$	PM-60.1	14-GJG
5		PM-60.1	14-GKF-B
6		PM-60.1	14-GMF-B
Class 21 Lighting Contactor			21-GWE
Competitive Product Comparison			
Size 1 Starters 14-PC2			
Furnas The Right Choice Form 1485			
Specifying a NEMA Rated Starter Form 1555			

AC Controls

Lighting and Heating Contactors

Table 15.15 Type CLH Multi-Pole Electrically-Held Lighting and Heating Contactors (Open Type)

Ampere Rating	No. of Poles	Dimensions In Inches (mm)		
		Height (H)	Width (W)	Depth (D)
20	2/4	2.95 (75)	1.77 (45)	3.93 (99.82)
	6/8 10/12		6.88 (175)	
30	3	2.95 (75)	1.77 (45)	4.23 (107.44)
30	6/9	2.95 (75)	6.88 (175)	4.44 (112.77)
	12		8.85 (225)	
60	3	4.60 (117)	3.54 (90)	4.44 (112.77)
	6/9/12	15.98 (406)	15.47 (393)	
100	3	5.23 (133)	3.93 (100)	5.51 (140)
200	3	7.08 (180)	5.31 (135)	7.28 (185)
300	3	7.87 (200)	5.70 (145)	7.79 (198)
400	3	7.87 (200)	6.29 (160)	8.74 (222)

Table 15.16 Type CLB, CLF, CLN 3-Pole Electrically-Held Combination Lighting and Heating Contactors (Combination Fusible, Non-Fusible, or Circuit Breaker)

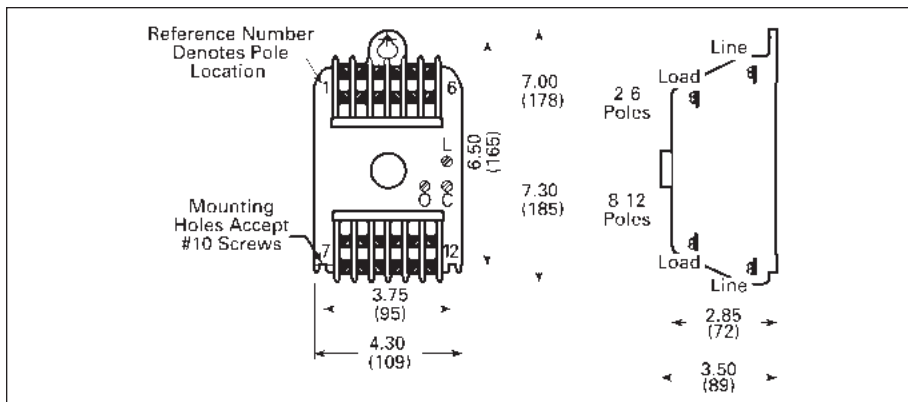
Ampere Rating	No. of Poles	Dimensions In Inches (mm)					
		NEMA 1 Enclosed			NEMA 3R / 12 Enclosed		
		Height (H)	Width (W)	Depth (D)	Height (H)	Width (W)	Depth (D)
20 30 60	3	24.0 (610)	10.0 (254)	8.0 (203)	24.0 (610)	10.0 (254)	8.0 (203)
100	3	24.0 (610)	20.0 (508)	8.0 (203)	24.0 (610)	20.0 (508)	8.0 (203)
200	3	36.0 (914)	24.0 (610)	12.5 (318)	36.0 (914)	24.0 (610)	12.5 (318)
300	3	48.0 (1219)	30.0 (762)	12.5 (318)	48.0 (1219)	30.0 (762)	12.5 (318)

Table 15.17 Type CLH Multi-Pole Electrically-Held Lighting and Heating Contactors

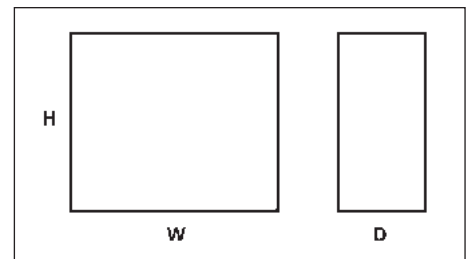
Ampere Rating	No. of Poles	Dimensions In Inches (mm)					
		NEMA 1 Enclosed			NEMA 3R / 12 & 4 Enclosed		
		Height (H)	Width (W)	Depth (D)	Height (H)	Width (W)	Depth (D)
20	2-12	14.06 (357)	6.81 (173)	6.65 (169)	15.0 (381)	10.75 (273)	6.48 (165)
30	3	10.05 (255)	5.56 (141)	5.33 (135)			
30	6 / 9 / 12	14.06 (357)	6.81 (173)	6.65 (169)			
60	3	14.06 (357)	6.81 (173)	6.65 (169)	22.0 (559)	11.0 (279)	7.8 (198)
60	6-12	20.0 (508)	16.0 (406)	9.88 (251)			
100	3	20.0 (508)	9.0 (229)	7.72 (196)	22.0 (559)	11.0 (279)	7.8 (198)
200	3	22.0 (559)	10.5 (267)		32.0 (813)	18.0 (457)	11.0 (279)
300	3	32.0 (813)	18.0 (457)	11.0 (279)	32.0 (813)	18.0 (457)	11.0 (279)
400	3	32.0 (813)	18.0 (457)	11.0 (279)	32.0 (813)	18.0 (457)	11.0 (279)

Table 15.18 Type CLM Multi-Pole Mechanically-Latched 20 Ampere Lighting and Heating Contactor

Ampere Rating	No. of Poles	Dimensions In Inches (mm)					
		NEMA 1 Enclosed			NEMA 3R / 12 & 4 Enclosed		
		Height (H)	Width (W)	Depth (D)	Height (H)	Width (W)	Depth (D)
20	2-12	14.06 (357)	6.81 (173)	6.65 (169)	15.0 (381)	10.75 (273)	6.48 (165)



20 Ampere CLM Open Contactor



AC Controls

Compact Magnetic Contactors Lighting

General

Electrically Held, 20A 60Hz 480VAC Max Tungsten, 600VAC Ballast

Table 15.19 21WE 2-12 Pole

Poles	Contacts Normally Open	Normally Closed	Open Type	Nema 1 General Purpose
			Cat No.	Cat No.
2	2	0	21WE20A*	21WE20B*
3	3	0	21WE30A*	21WE30B*
4	4	0	21WE40A*	21WE40B*
4	3	1	21WE31A*	21WE31B*
4	2	2	21WE22A*	21WE22B*
6	6	0	21WE60A*	21WE60B*
6	4	2	21WE42A*	21WE42B*
8	8	0	21WE80A*	21WE80B*
8	6	2	21WE62A*	21WE62B*
8	4	4	21WE44A*	21WE44B*
9	9	0	21WE90A*	21WE90B*
9	7	2	21WE72A*	21WE72B*
9	5	4	21WE54A*	21WE54B*
10	10	0	21WE100A*	21WE100B*
10	8	2	21WE82A*	21WE82B*
10	6	4	21WE64A*	21WE64B*
12	12	0	21WE120A*	21WE120B*
12	10	2	21WE102A*	21WE102B*
12	8	4	21WE84A*	21WE84B*

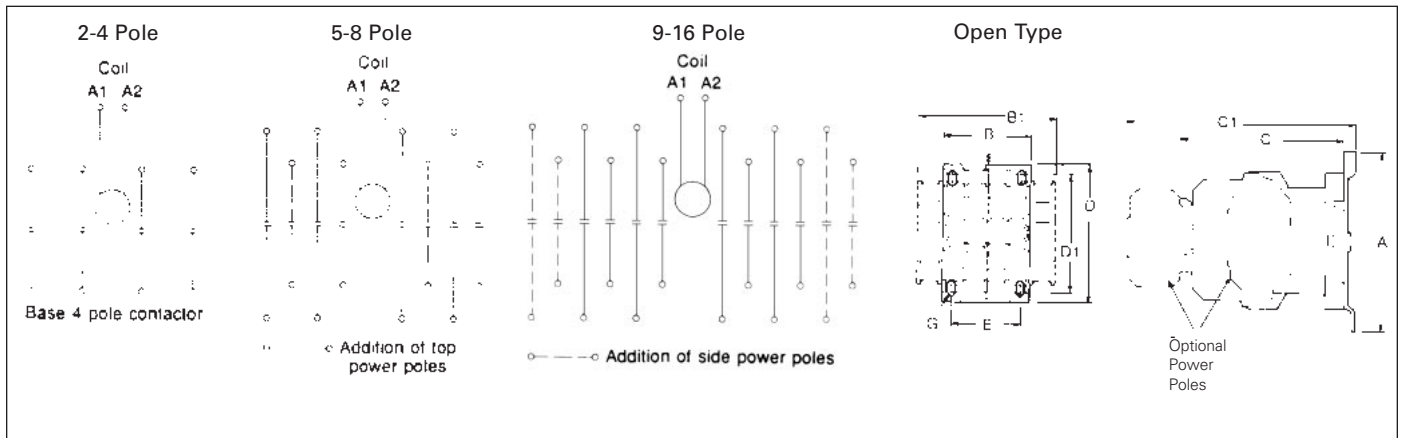
Table 15.20 Adder Decks

Type	50 Hz	Part No.
Side Mounted Light Power Pole	1 NO	21WS10
	1 NC	21WS01
	2 NO	21WS20
	1 NO & 1 NC	21WS11
	2 NC	21WS02
Top Mounted Light Power Pole	2 NO	21WT20
	2 NC	21WT02
	4 NO	21WT40
	2 NO & 2 NC	21WT22
	4 NC	21WT04

Table 15.21 2-12 Pole Dimensions

No. of Poles	Dimensions in Inches (mm)				
	A	B	B ₁	C	C ₁
2-4	4.88 (124)	2.00 (51)	—	3.44 (87)	—
6-8	4.88 (124)	2.00 (51)	—	—	4.50 (114)
10-10	4.88 (124)	—	2.25 (57)	—	4.50 (114)

Wiring Diagrams (Typical)



AC Controls

Lighting and Heating Contactors

CLM Contactors — 30 to 200 Ampere

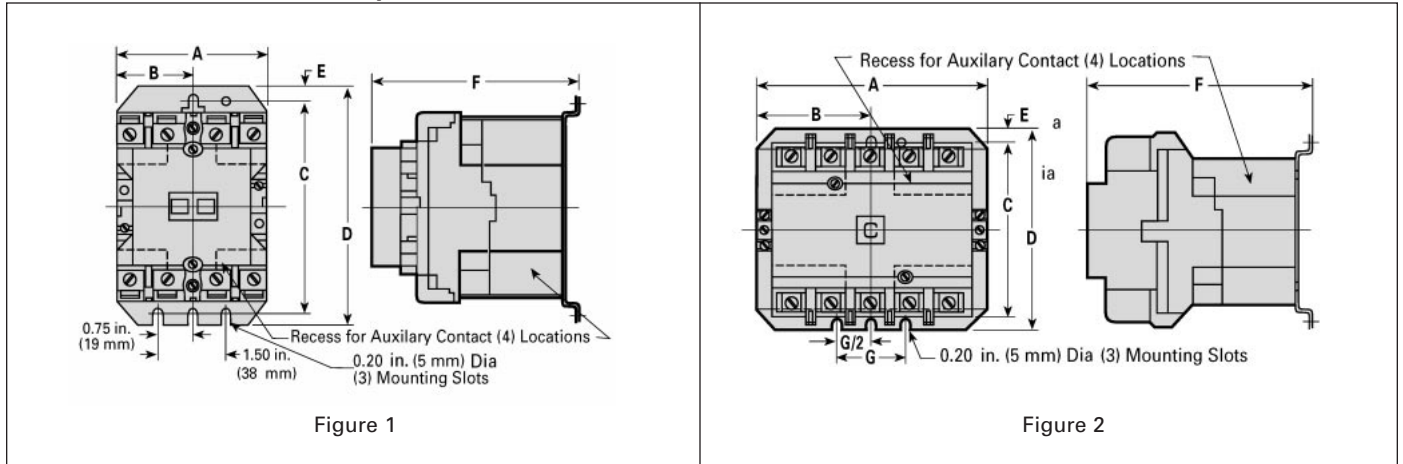
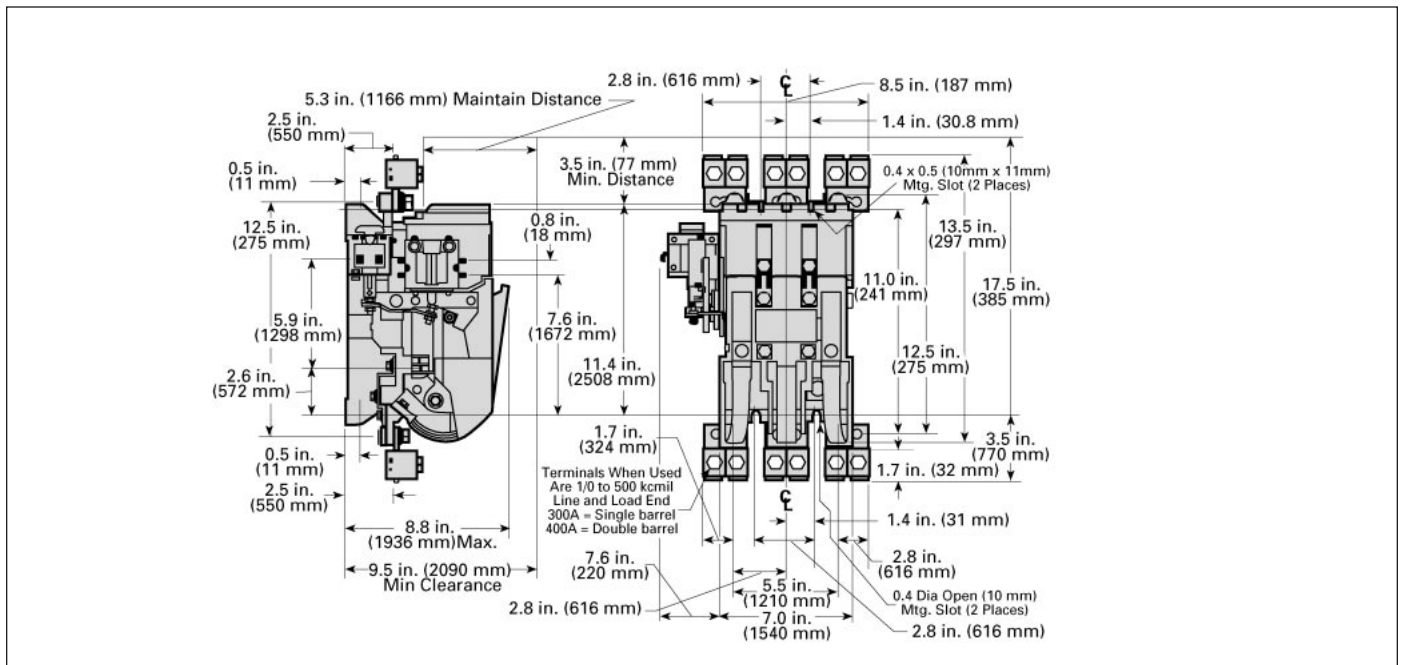


Table 15.22 Type CLM Magnetically Latched 30A to 200A Lighting and Heating Contactors — Open Type

Ampere Rating	No. of Poles	Figure No.	Dimensions In Inches (mm)							Shipping Weight in lbs. (kg)
			A	B	C	D	E	F	G	
30	2-4	1	3.31 (84)	1.65 (42)	3.95 (100)	4.38 (111)	0.23 (6)	4.61 (117)	1.50 (38)	3.3 (2)
	5		4.19 (106)	2.09 (53)	3.48 (88)			4.5 (2)		
60	2-3	2	3.31 (84)	1.65 (42)	3.95 (100)	6.62 (168)	0.38 (10)	4.94 (125)	1.88 (48)	3.3 (2)
	4-5		5.06 (129)	2.53 (64)	3.48 (88)			4.5 (2)		
100 / 200	2-3	2	4.62 (117)	2.31 (59)	6.00 (152)	6.62 (168)	0.38 (10)	6.75 (171)	1.88 (48)	9.3 (4)
	4-5		7.25 (184)	3.62 (92)	6.00 (152)			13.0 (6)		

CLM Contactors — 300 and 400 Amperes, 2- and 3-Pole



Dimensions in inches (mm) for reference purposes only.



Type CLM Magnetically-Latched, 30-400A

Description

AC lighting contactors provide a safe convenient means of local or remote switching of relatively large tungsten, fluorescent or mercury arc lamp loads.

Siemens AC lighting contactors are designed to withstand the large initial inrush currents of tungsten lamp loads without the contacts welding. They are fully rated contactors and do not require any derating as do standard motor control contactors. They are UL Listed and CSA Certified.

Magnetic Latch Operation

A permanent magnet is built into the contactor structure of the 30, 60, 100, and 200 ampere contactors that will maintain the contactor in its energized state indefinitely without using control power. When energized, a DC current is applied that produces a magnetic field that reinforces the polarity of the permanent magnet, and the contactor pulls in immediately. The current to the coil is disconnected by the coil clearing interlock. In order to drop out the contactor it is necessary to apply a field through the OFF coil in the reverse direction to the permanent magnet. This momentarily cancels the magnetic attraction and the contactor drops out.

Cu / Al terminals are provided as standard except on 30 ampere devices which are for copper wire only.

Ballast Load:

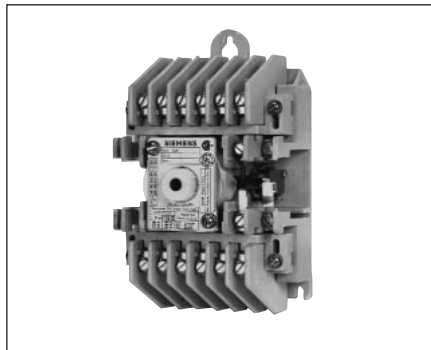
600 volts AC, breaking all lines. Tungsten Lamp Loads, Max. Volts:

Line-to-Line, 480 AC

Line-to-Neutral, 277 AC

Combination Lighting Contactors

It is desirable to install the branch circuit protective device and lighting contactor, combining switching and over-current protection, in one enclosure.



Type CLM Magnetically-Latched, 20A Multi-Pole

Combination lighting contactors are well suited for industrial, highway and area lighting applications, or where a lighting circuit may have to be disconnected for periodic maintenance. They may also be used for resistance heating loads.

CLM Lighting Contactors

The CLM Lighting Contactors can be used with metal halide, mercury vapor, quartz halogen, tungsten, and fluorescent lighting. They provide reliable and convenient lighting control in numerous applications, such as industrial plants, schools, hospitals, office buildings, shopping centers, airports, stadiums, etc. The CLM's are listed under UL 508 with no derating when used open or enclosed. Optional solid-state control modules are available to allow control of the CLM lighting contactors directly from energy management systems, microprocessors, photoelectric cells, timers, and similar control devices. They permit programmable time scheduling of loads, automatic control of lighting near windows to allow the use of natural ambient lighting levels, and manual override of all lighting circuits from any number of local control stations or from a central location. These optional modules are integrally mounted onto the base of the lighting contactor.

Table 15.23 20 Ampere CLM

Max. AC Voltage and Ampere Ratings			
Load Type	Amps Cont.	Poles to Load	
		1 for 1-Phase	2 for 1-Phase 3 for 3-Phase
Tungsten	20	250V AC	—
Ballast	20	347V AC	600V AC
General	30	347V AC	600V AC
Max. DC Voltage and Ampere Ratings			
Load Type	Amps Cont.	Poles to Load	
		2 in Series	3 in Series
General	20	125V DC	250V DC



Type CLM Electrically-Held (20-400A)

CLH Lighting Contactors

Class CLH electrically-held lighting contactors provide a safe convenient means of local or remote switching for tungsten and ballast lamp loads, mercury arc lamps, 3 phase resistive heating, 480 volts line to line, 277 volts line to neutral. Available in 20 ampere through 400 ampere sizes in NEMA Type 1, 3R / 12, 4 stainless steel, 4X non-metallic type enclosures and open type. The CLH contactors are available in 2–12 pole 20 ampere, 3–12 pole 30 and 60 ampere and 3 pole in 100–400 ampere sizes. UL Listed and CSA certified.

Table 15.24 CLH Lighting Contactors

3-Phase Tungsten and Ballast Lamp Loads 480V Line to Line 277V Line to Neutral	3-Phase Non-Motor Loads 3-Phase Mercury ARC Lamps 3-Phase Resistive Heating	No. of Poles
20	20	2, 3, 4, 6, 8, 10, 12
30	30	3, 6, 9 & 12
60	60	3, 6, 9 & 12
100	100	3
200	200	3
300	300	3
400	400	3

Combination Lighting and Heating Features:

- Disconnect Switch and Circuit Breaker Types
- Rugged Flange Mounted Handle
- Easy Installation
- Occupies Less Space
- Increased Operator Protection
- Room To Spare for Modifications
- Class R Fuses Standard
- Electrically and Mechanically Held
- 30–300 Amperes
- UL Listed

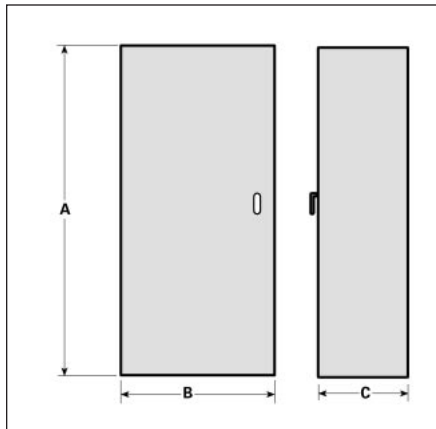
AC Controls

Combination Starters (NEMA Sizes 0–4)



Combination Starter With Type MCS Disconnect Switch

Dimensions



Combination Starter With ETI Circuit Breaker

The Type ETI circuit breaker, sometimes called a Motor Circuit Interrupter, is a device designed specifically for application in motor circuits. The ETI is a magnetic only protective device designed to provide protection against short circuit current.

The instantaneous-only type ETI circuit breaker employs adjustable magnetic trip settings to allow broader application ranges and a higher degree of motor short circuit protection.

Type MCS Disconnect Switches

Type MCS Disconnect Switches feature a quick-make, quick-break mechanism to insure proper switch operation. With a high fault withstand rating of 100 kA at 480 volts ac, when fused with Class R rated size fuses, MCS switches meet stringent industry standards set forth by the automotive, petro-chemical, and pulp and paper industries.

With visible blade contacts for ease of inspection, removable line shields, and front removable fuse clips and lugs, disconnect switches are UL recognized and CSA certified. They are available with Class H, J, and R fuse kits for a wide range of fused, non-fused, and over-fusing options.

Table 15.25 3-Phase Magnetic Motor Starter

NEMA Starter Size	Half Size	Maximum Horsepower		
		200V	230V	460/575V
0		3	3	5
1		7.5	7.5	10
	1 3/4	10	10	15
2		10	15	25
	2 1/2	15	20	30
3		25	30	50
	3 1/2	30	40	75
4		40	50	100

Table 15.26 Magnetic Motor Starter

	Dimensions in Inches (mm)			
	Size	A	B	C
NEMA 1 General Purpose Standard Width 0–4	0–1 3/4	23.25 (591)	11.00 (279)	7.63 (194)
	2, 2 1/2	26.75 (679)	12.13 (308)	7.63 (194)
	3	31.50 (800)	12.50 (318)	7.63 (194)
NEMA 1 General Purpose Standard Width 3 1/2–4	3 1/2, 4	48.97 (1244)	12.13 (308)	9.94 (252)
NEMA 12 Industrial Use Standard Width 0–4	0–2 1/2	29.50 (749)	12.13 (308)	7.69 (195)
	3	34.25 (870)	12.50 (318)	7.69 (195)
NEMA 12 Industrial Use Standard Width 3 1/2–4	3 1/2, 4	48.94 (1243)	19.13 (486)	9.94 (252)

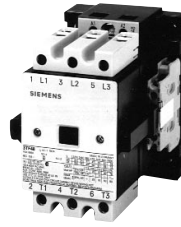
AC Controls

Contactors — Non-Reversing

General



NEMA Size 1



NEMA Size 3



NEMA Size 5

Type 3TF Non-Reversing AC Contactors

Key Features

- Fully NEMA Rated Sizes 00–8
- Double Break Contacts
- Silver Tin Oxide Contacts, Cadmium-Free (Sizes 00–5)
- Higher Locked Rotor Current Ratings, Up to 840% (Sizes 00–5)
- Arc Chutes with Arc Splitters; Fast Arc Quenching
- Lowest Contact Bounce (2 Milliseconds or less on Most Sizes)
- Touch Safe Power Terminals (Sizes 00–3)
- Touch Safe Control Terminals (Sizes 00–5)
- Snap-on 2 NO and 2 NC Auxiliary Contacts Standard (Sizes 00–5)
- Visual ON/OFF indicator
- Color-Coded Coils
- Fast Termination System — Wire Funnel, Wire Stops, Screwdriver Guide Holes, and Captive Hardware
- Long Mechanical Life — 15 Million (Size 00) — 10 Million (Size 0–5) — 5 Million (Size 6–8)
- UL Listed and CSA Certified

Table 15.27 Contactor Technical Data

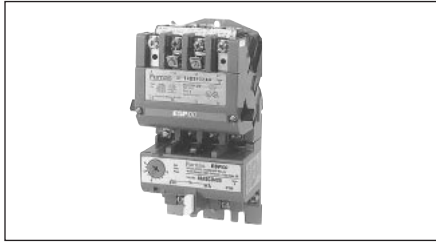
Measured Parameter		NEMA Size										
		00	0	1	2	3	4	5	6	7	8	
Ampere Rating (Open)	Amps	10	20	30	50	100	150	300	600	900	1350	
Ampere Rating (Enclosed)	Amps	9	18	27	45	90	135	270	540	810	1215	
Maximum Voltage Rating	Volts	600	600	600	600	600	600	600	600	600	600	
Squirrel Cage Motor Maximum Horsepower	200 V, 60 Hz	1.5	3	7.5	10	25	40	75	150	—	—	
	230 V, 60 Hz	1.5	3	7.5	15	30	50	100	200	300	450	
	380 V, 50 Hz	1.5	5	10	25	50	75	150	300	—	—	
	460–575 V, 60 Hz	2	5	10	25	50	100	200	400	600	900	
Resistive Heating (1-Phase 2-Pole)	120 VAC	—	—	3	5	10	15	30	60	90	⓪	
	240 VAC	—	—	6	10	20	30	60	120	180	⓪	
	480 VAC	—	—	12	20	40	60	120	240	360	⓪	
	600 VAC	—	—	15	25	50	75	150	300	450	⓪	
Resistive Heating (3-Phase 3-Pole)	120 VAC	—	—	5	8.5	17	26	52	105	155	⓪	
	240 VAC	—	—	10	17	34	68	105	210	315	⓪	
	480 VAC	—	—	20	34	68	105	210	415	625	⓪	
	600 VAC	—	—	25	43	86	130	260	515	775	⓪	
Capacitor Switching (3-Phase)	240 VAC	—	—	—	12	27	40	80	160	240	360	
	480 VAC	—	—	—	25	53	80	160	320	480	720	
	600 VAC	—	—	—	31	67	100	200	400	600	900	
Transformer Switching (1-Phase 2-Pole)	120 VAC	—	0.6	1.2	2.1	4.1	6.8	14	27	41	61	
	240 VAC	—	1.2	2.4	4.1	8.1	14	27	54	81	122	
	480 VAC	—	2.4	4.9	8.3	16	27	54	108	162	244	
	600 VAC	—	3	6.2	10	20	34	68	135	203	304	
Transformer Switching (3-Phase 3-Pole)	208 VAC	—	1.8	3.6	6.3	12	30	41	81	122	182	
	240 VAC	—	2.1	4.3	7.2	14	23	47	94	140	210	
	480 VAC	—	4.2	8.5	14	28	47	94	188	280	420	
	600 VAC	—	5.2	11	18	35	59	117	1350	351	525	
AC Coil Ratings	Overall	Hz	50/60	50/60	50/60	50/60	50/60	50/60	60	60	60	
	Inrush	VA	68/87	101/32	101/32	183/233	330/410	910/1090	2450/2960	2900	4000	4200
	Sealed	VA	10/12	12.1/16.1	12.1/16.1	17/21	32/39	58/70	115/146	105	140	100
Operating Times (valid for 20% Undervoltage)	to 10% overvoltage, (warm or cold coil) Total Opening Time Includes Arcing Time Closing Delay	MS	10–35	13–67	13–67	15–40	20–50	20–50	17–65	30–50	30–50	40–80
Operating			15–30	15–20	15–20	15–35	15–35	20–40	18–30	10–20	10–20	140–240
Resistance To Shock (Rectangular pulse)	G/MS	5.5/5 3.2/10	5.7/5 9/5	5.7/5 9/5	9.2/5 4.8/10	8.6/5 4.8/10	10.4/5 5.8/10	8.8/5 4.9/10	—	—	—	
Conductor size/phase	AWG	(2) 14–10	(2) 14–3	10–1/0	10–1/0	10–1/0	2-300MCM	1-500MCM	(2) 4–500	(3) 2–600MCM	(4) 2/0–500MC	
Auxiliary Contact Wire Size	AWG	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	(2) 18–12	
Mechanical Life (make/break operations)	MILL	15	10	10	10	10	10	10	5	5	5	
Total Auxiliary Contacts Available		4	4	4	8	8	8	8	8	8	8	
Auxiliary Contact Rating A600/P600		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

⓪ For ratings contact Siemens.

AC Controls

Magnetic Motor Starters — Full Voltage Non Reversing

Starters



Size 0–1 $\frac{3}{4}$
With ESP100 Solid State Overload

Key Features (Cont'd)

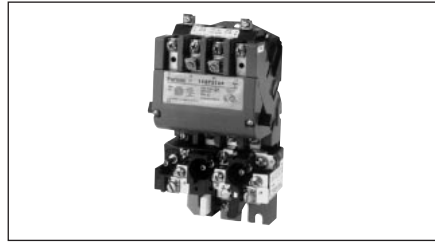
- Rugged Industrial Design
- Dual Voltage, Dual Frequency Coils
- Overload Test Feature
- Front Removable Auxiliary Contacts
- Wide Range of Accessories
- Easy Coil Access
- Widest Selection of Overloads in the Industry
- Solid State, Melting Alloy, Bimetal, or Bimetal Ambient Compensated Overload Protection
- Exclusive Half Sizes
- Straight Through Wiring
- Gravity Dropout
- Large Silver Cadmium Contacts
- UL Listed 508 File #E14900
- CSA Certified File #LR6535
- Universal Mounting Plate

Application

Class 14 industrial magnetic starters are designed for across-the-line starting of single-phase and polyphase motors.

ESP100 starters combine the rugged characteristics of a NEMA rated contactor with a solid state overload which provides phase loss protection. It offers the industrial user greater protection and added life for motors in heavy duty applications. The inherent benefits of the ESP100 result in cost savings as well.

Starter with **thermal overload relays** (together with the proper heater elements) help provide protection to motor windings from harmful currents and the resultant temperature rise that may be caused by overloading the motor, sustained low line voltage, or stalled rotor.



Size 0–1 $\frac{3}{4}$
With Melting Alloy Overload

These controls are available in NEMA sizes 00 through 6. ESP100 starters are available in NEMA sizes 0 through 6. In addition to the usual NEMA starter sizes, four exclusive Half Sizes—1 $\frac{3}{4}$, 2 $\frac{1}{2}$, 3 $\frac{1}{2}$, and 4 $\frac{1}{2}$ —are offered. These integral sizes offer the same rugged, industrial construction as NEMA sizes, and ensure efficient operating performance. Half Sizes provide a real cost savings by cutting down on over capacity when NEMA sizes exceed the motor ratings.

Across the line or full voltage starting is used when motor starting torque can be applied safely and current inrush does not produce an objectional voltage drop. All starters are supplied with a NO holding contact that in conjunction with an appropriate pilot device will provide low voltage protection or release.

Features

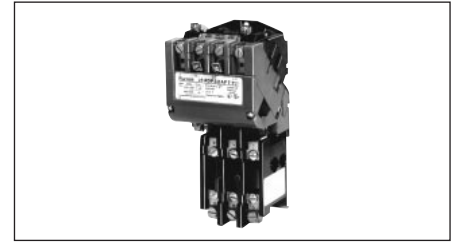
Size 0–6 Magnetic Starters include the following standard features:

Molded Coil — Magnetic coils are carefully wound and then sealed in epoxy. Encapsulation helps seal out moisture, promotes heat transfer, and resists electrical, mechanical, and thermal stresses.

Dual Voltage / Dual Frequency Coil — Starters are available with dual voltage, dual frequency coils. They are designed to operate on either 50 or 60 Hertz.

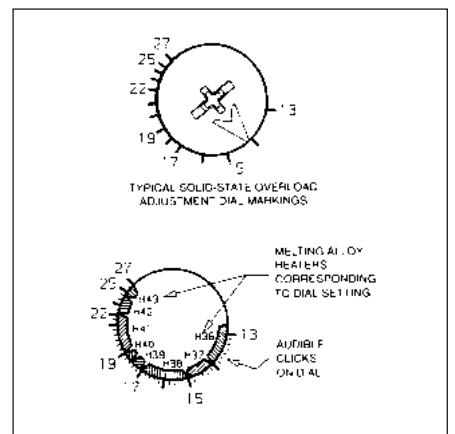
ESP100 Solid State Overload Relays — These standard features of the ESP100 provide Extra Starter Performance.

- True phase loss protection; trips within 3 seconds.
- High accuracy trip curves; $\pm 2\%$ repeat trip accuracy.
- Ease of use. Mount, wire and set FLA.
- Overload is self protected against short circuits.



Size 0–1 $\frac{3}{4}$
With Bimetal Overload

- Overload is self powered and requires no hard wiring or separate power source.
- Simple, versatile adjustment; over a 2:1 FLA adjustment range. Extendable to 4:1 with looping option.
- Heaterless construction minimizes energy costs and the costs of cabinet ventilation or cooling.
- Class 20 protection is standard. Class 10 and 30 protection are available.
- Provides motor protection to 50 / 60 Hertz.



Thermal Overload Relays — Melting alloy is supplied as standard; optional bimetal overload relay is available. Ambient compensated bimetal version is also available. Bimetal types are convertible from manual to automatic reset and can be furnished with standard or quick trip heater elements. Melting alloy overloads include a trip indicator and manual test feature. An isolated normally open or normally closed contact is available for use on melting alloy overloads. Bimetal overloads are also available with NC and NO (SPDT) Form C contacts.

AC Controls

Magnetic Motor Starters—Full Voltage Non Reversing

General

Auxiliary Equipment

- Starters are available with built-in START / STOP pushbuttons for 3-wire control or a HAND / OFF / AUTO selector switch for 2-wire control.
- Field modifications such as auxiliary electrical contacts, pilot lights, push-buttons, selector switches, and fuse blocks for low voltage pilot control are available to meet specific application requirements.
- Normally open or normally closed fifth power pole kits are available for sizes 0 through 1¾.
- Transformers and pneumatic timers can be ordered as either factory or field modifications. In some cases these may require a larger enclosure.
- A full line of replacement parts are available including contact kits, coils, overload relays, and heater elements.

Size 0 through 4

The following features are characteristics of Sizes 0 through 4.

Gravity Dropout — For added reliability, the gravity dropout of the armature and contacts is assisted by stainless steel springs which help provide quick, precise opening of the contacts. Also provides straight through wiring.

45 Degree, Wedge Action — The 45 degree, wedge action contacts reduce tracking and provide faster arc quenching. The resulting self cleaning and reduced contact bounce mean cooler operation and longer life for the large silver cadmium oxide contacts.

Terminal Design — Control terminals are self rising pressure type.

Auxiliary Contacts — Front mounted as well as side mounted auxiliary contacts are available. A maximum of four can be mounted on sizes 0 through 1¾, three on Sizes 2 through 6.

Table 15.28 Coil Data

Class 14 Size	Watts	Volts	Inrush (Open Magnet)		Normal (Sealed Magnet)	
			Amps	VA	Amps	VA
00	13.3	24	2.63	70	.37	10
		120	.59		.08	
		208	.34		.05	
		240	.305		.045	
		277	.25		.03	
		480	1.49		.02	
600	.121	.02				
0 thru 2½	8.6	24	9.08	218	1.04	25
		120	1.82		.21	
		208	1.05		.12	
		240	.91		.105	
		277	.79		.090	
		480	.45		.052	
600	.36	.042				
3, 3½	14	24	12.9	310	1.08	26
		120	2.58		.217	
		208	1.49		.125	
		240	1.29		.108	
		277	1.12		.094	
		480	.646		.054	
600	.516	.043				
4	22	120	4.25	510	.425	51
		208	2.45		.245	
		240	2.14		.215	
		277	1.77		.183	
		480	1.08		.112	
		600	.85		.085	
4½, 5	63	120	12.65	1518	.96	116
		240	6.32		.48	
		480	3.16		.24	
		600	2.53		.193	
6	40	240	1.45	350	.25	60
		480	.73		.12	
		600	.58		.10	

Magnetic Contactors

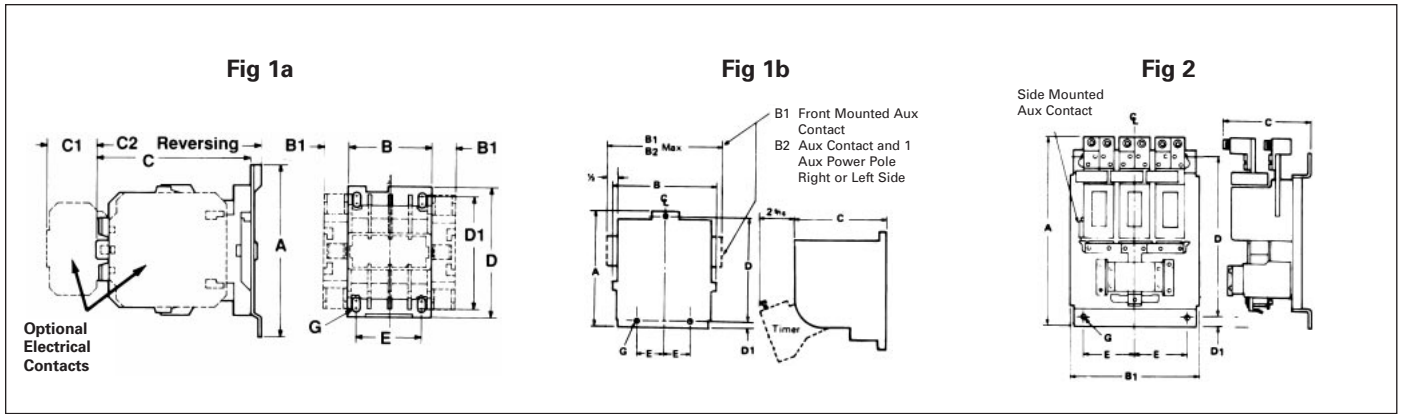
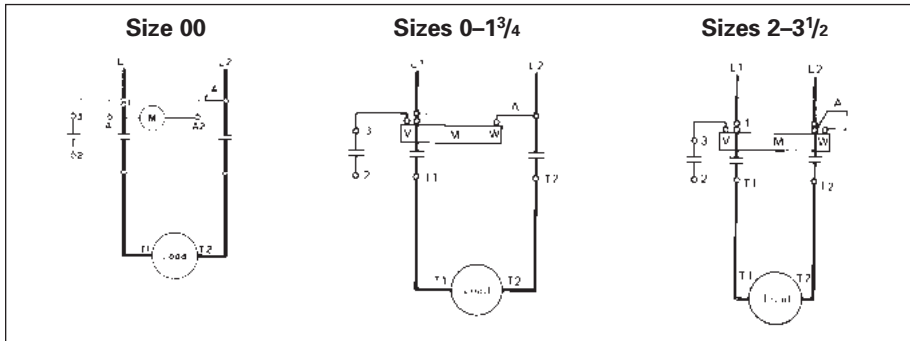


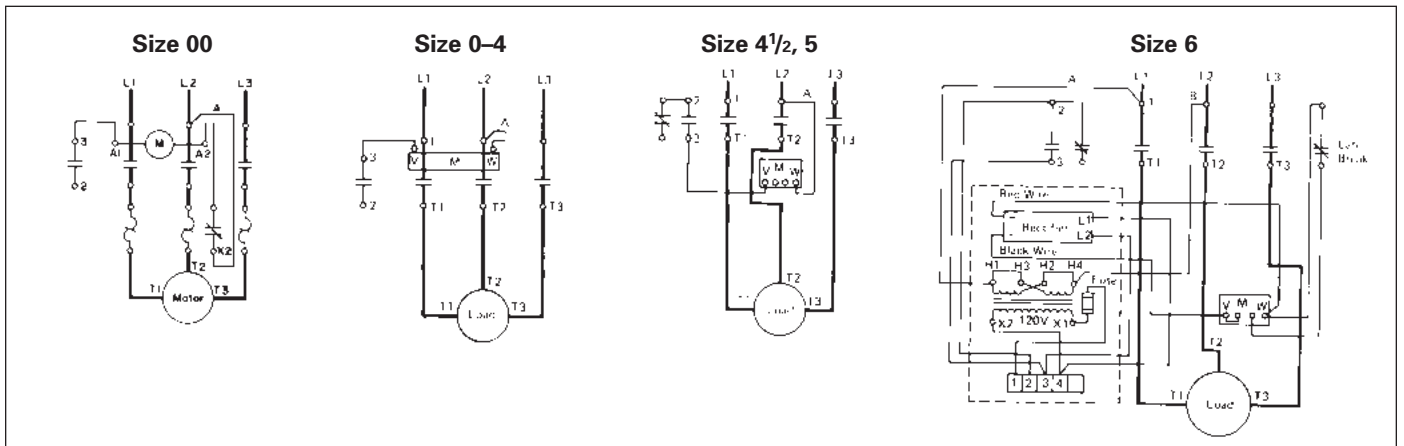
Table 15.29 Contactor Dimensions

Type	Dimensions in Inches (mm)			NEMA Size	Half Size	Figure
	A	B	C			
Open	3.75 (95)	5.50 (140)	3.19 (81)	00		1a
	4.31 (109)	4.75 (121)	3.75 (95)	0-1		1b
	4.31 (109)	4.75 (121)	3.75 (95)		1/4	1b
	4.88 (124)	4.25 (110)	4.00 (102)	2		1b
	4.88 (124)	4.50 (114)	4.00 (102)		2 1/2	1b
	6.13 (156)	5.50 (140)	5.06 (129)	3		1b
	6.13 (156)	5.50 (140)	5.06 (129)		3 1/2	1b
	7.81 (198)	5.50 (140)	5.75 (146)	4		2
	17.38 (441)	—	7.88 (200)		4 1/2	2
	17.38 (441)	—	7.88 (200)	5		2
22.50 (572)	—	10.00 (254)	6		2	

2 Pole Single Phase Magnetic Contactors



3 Pole 3 Phase Magnetic Contactors



Magnetic Contactors

Enclosures

Table 15.30 Enclosure Dimensions

	Size	Outline Dimensions			Fig
		A	B	C	
NEMA 1 General Purpose Enclosures	00	9 ^{5/8}	6 ^{1/8}	4 ^{15/16}	1
	0-1 ^{3/4}	11	6 ^{1/4}	4 ^{3/8}	2, 2a
	2, 2 ^{1/2}	13 ^{1/2}	7 ^{13/16}	4 ^{11/16}	2, 2a
	3, 3 ^{1/2}	19	11 ^{1/4}	6 ^{1/8}	2, 2b
	4	26	13 ^{1/8}	7 ^{9/16}	3, 3b
	4 ^{1/2} , 5	39 ^{13/16}	17 ^{9/16}	10 ^{9/16}	3, 3a
NEMA 3 Weatherproof Enclosures	6	45 ^{13/16}	21 ^{9/16}	11 ^{9/16}	3
	0-1 ^{1/2}	13	7 ^{3/4}	5 ^{1/2}	4
	2, 2 ^{1/2}	16	8 ^{1/8}	6 ^{1/8}	4
	3	26	13 ^{1/8}	7 ^{13/16}	4
	3 ^{1/2} -4	26	13 ^{1/8}	7 ^{13/16}	4
	4 ^{1/2} -5	39 ^{13/16}	17 ^{9/16}	10 ^{9/16}	4
NEMA 4 Watertight Enclosures	6	45 ^{13/16}	21 ^{9/16}	12 ^{1/4}	4
	0-1 ^{3/4}	13	7 ^{3/4}	5 ^{5/16}	5
	0-2 ^{1/2}	16	8 ^{1/8}	6 ^{1/16}	5
	3	26	13 ^{1/8}	7 ^{9/16}	5
	3 ^{1/2} -4	26	13 ^{1/8}	7 ^{9/16}	5
	4 ^{1/2} , 5	39 ^{13/16}	17 ^{9/16}	10 ^{9/16}	5
NEMA 4X Watertight Corrosion Resistant Enclosures	6	45 ^{13/16}	21 ^{9/16}	11 ^{9/16}	5
	0-2	11 ^{7/8}	7 ^{5/16}	6 ^{7/8}	6
	2 Bimetal				
	2 ^{1/2}	14 ^{11/16}	11 ^{7/8}	6 ^{7/8}	6
	3, 3 ^{1/2}	23 ^{3/4}	11 ^{7/8}	6 ^{7/8}	6
	4	23 ^{3/4}	11 ^{7/8}	9 ^{1/4}	6
NEMA 7 & 9 Hazardous Location Enclosures	0-2 ^{1/2}	14 ^{5/8}	9 ^{1/8}	8 ^{1/2}	7
	3, 3 ^{1/2}	22 ^{3/4}	13 ^{1/4}	9 ^{1/4}	7
	4	28 ^{1/2}	17 ^{1/2}	11 ^{1/4}	7
	4 ^{1/2} , 5	43	19	12 ^{1/4}	8
NEMA 12 Industrial Use Enclosures	0-1 ^{3/4}	13	7 ^{3/4}	5 ^{7/16}	9
	2, 2 ^{1/2}	16	8 ^{1/8}	6 ^{1/16}	9
	3-4	26	13 ^{1/8}	7 ^{9/16}	9
	4 ^{1/2} -5	39 ^{13/16}	17 ^{9/16}	10 ^{9/16}	9
	6	45 ^{13/16}	21 ^{9/16}	11 ^{9/16}	9

Dimensions for reference, not for construction.

Figure 1

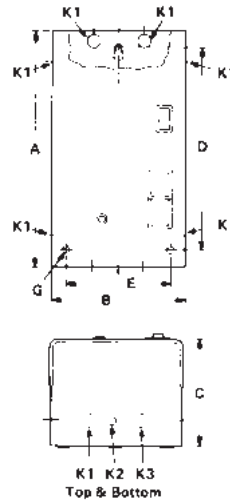


Figure 2

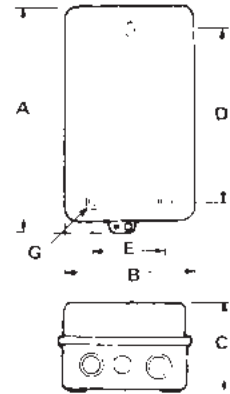


Figure 3

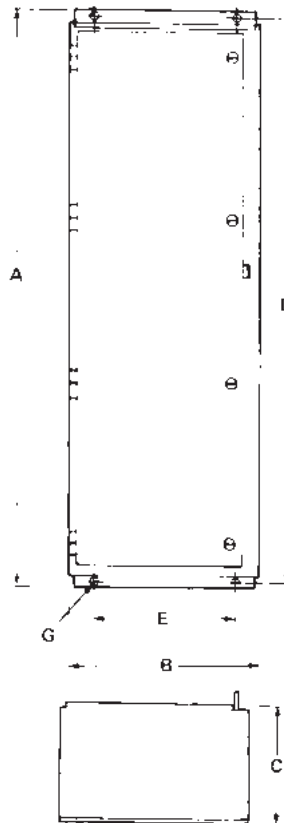


Figure 4
K1

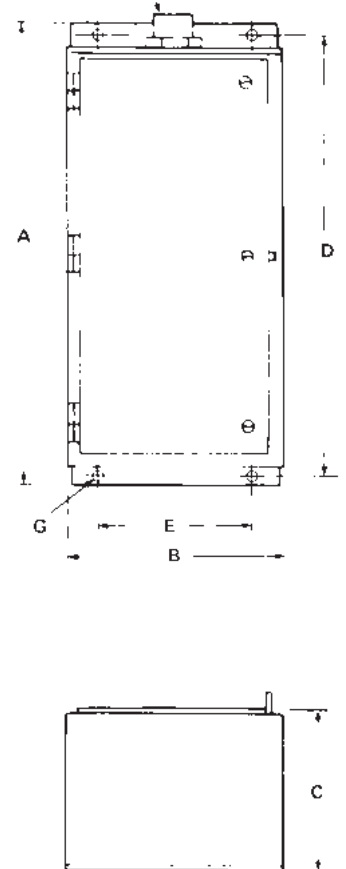


Figure 2a

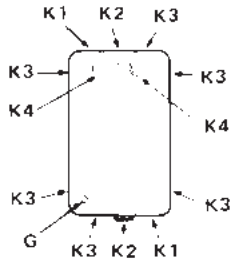
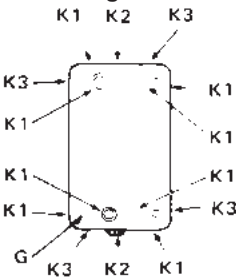
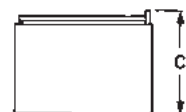
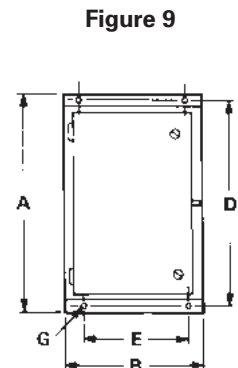
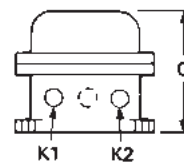
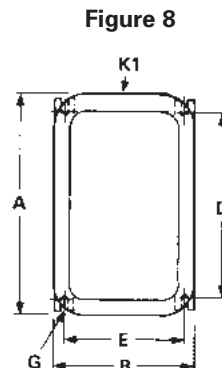
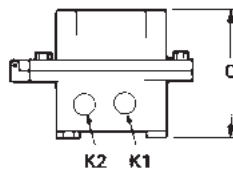
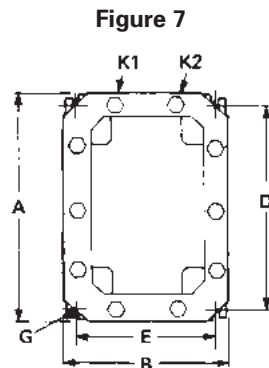
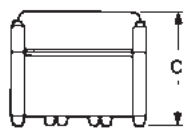
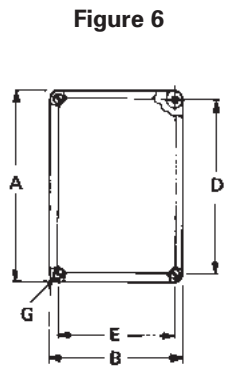
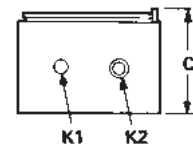
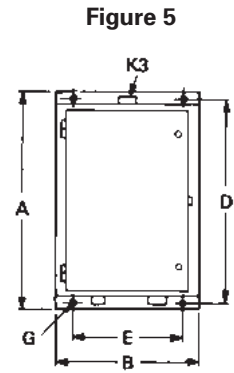
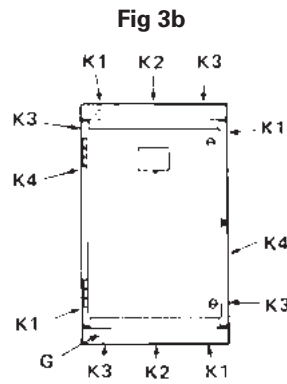
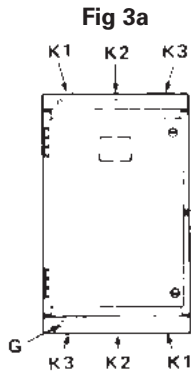


Fig 1c



Magnetic Contactors

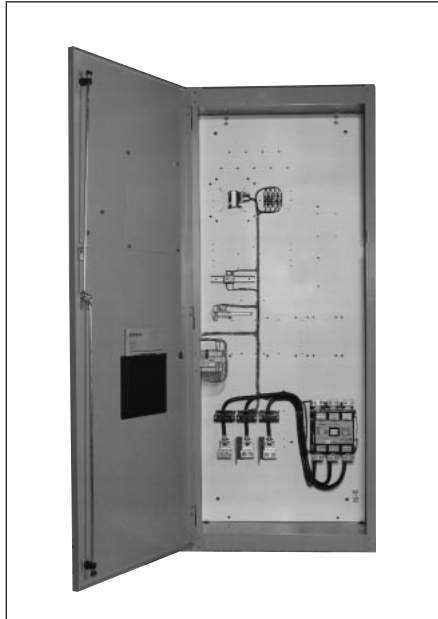
Enclosures



AC Controls

Full Voltage, Non-Reversing Starters (NEMA Sizes 6-8)

General / Dimensions



NEMA Size 6-8, Class SXL, Full Voltage, Non-Reversing Starters

Full Voltage Starters

3-Phase 250 to 900 HP, Non-Reversing and Reversing 50 / 60 Hz., NEMA Sizes 6-8 Full Voltage Starters are used for across the line starting of squirrel-cage induction motors and the primary control functions for wound rotor motors. In addition, they can be used for control of power for static or resistive loads such as lighting and heating. They provide the lowest cost, least maintenance, and minimum space requirements of any magnetic starters where inrush current limitations do not restrict their use. UL Listed and CSA Certified.

Overload Protection

Siemens solid-state overload relay protection is provided standard for starter sizes 6 through 8. Improvements in motor designs and manufacturing capabilities have resulted in decreasing physical motor size to obtain the same horsepower, making them more sensitive to overloads. Previous motors had a higher tolerance for overloads and made application of electromechanical overload relays satisfactory for protection. The bigger the motor, the more there is riding on marginal protection and high rewind costs.

Features

- Ambient Compensation from -25°C to $+55^{\circ}\text{C}$.
- Wide Adjustable Current Tripping Range.
- Detection of Overload, Phase Loss and Phase Unbalance.
- Isolated Contacts, 1-Normally Closed and 1-Normally Open Alarm Circuit Contact.
- Reset Button with Trip-Free Feature.
- Clear Plastic Sealable Cover to Prevent Unauthorized Tampering.
- UL Listed and CSA Certified.

Starter Types

SXL: Full Voltage, across the line Non-Reversing

SRL: Full Voltage, across the line Reversing

SCN: Full Voltage, across the line Non-Reversing, combination Non-Fusible

SCF: Full Voltage, across the line Non-Reversing, combination Fusible

SCB: Full Voltage, across the line Non-Reversing, combination Circuit Breaker

Note: Class designation revision (effective late 1994) does not affect starter designs.

	New	Old
SXL =		XL
SRL =		XR
SCN =		XLN
SCF =		XLF
SCB =		XLB

Enclosures

Construction is all welded, with an electrostatically applied powder epoxy baked finish, in ANSI-61 light gray.

Type 1: General Purpose

Type 3R: Outdoor Raintight

Type 12: Dusttight — Industrial Use

Type 4: Watertight Painted Sheet Steel

Ratings

Table 15.31 FVNR Starter Ratings

NEMA Size	Maximum 3-Phase HP Ratings at Motor Voltages			
	200V	230V	460V	575V
6	150	200	400	400
7		300	600	600
8		450	900	900

Dimensions

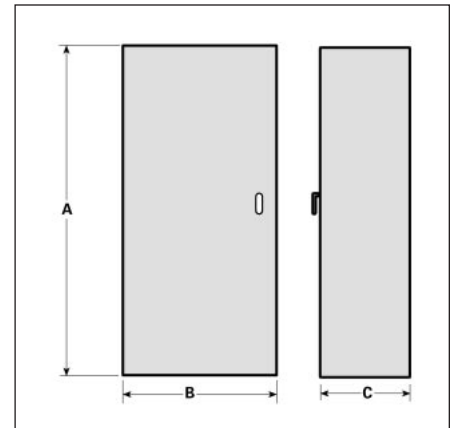


Table 15.32 Non-Reversing and Reversing Starters

Starter		Dimensions in inches (mm)		
NEMA Size	Type	A	B	C
Non-Reversing Starter Class: SXL, SCN, SCF, SCB				
6	Without Short Circuit Protection	76 (1930)	30 (762)	24 (610)
7		90 (2286)	30 (762)	24 (610)
8		*	*	*
6	With Fusible Disconnect	76 (1930)	30 (762)	24 (610)
7		90 (2286)	30 (762)	24 (610)
8		*	*	*
6	With Molded Case Breaker	76 (1930)	30 (762)	24 (610)
7		90 (2286)	30 (762)	24 (610)
8		*	*	*
Reversing Starter Class: SRL				
6	Without Short Circuit Protection	90 (2286)	30 (762)	24 (610)
7		90 (2286)	30 (762)	24 (610)
8		90 (2286)	44 (1118)	40 (1016)

AC Controls

Multi-Speed Starters (NEMA Sizes 0–4)



Full-voltage AC magnetic multi-speed controllers are designed to control reconnectable squirrel-cage induction motors for operation at two, three or four different constant speeds depending on the construction of the motor. These controllers are available in combination and non-combination types.

The speed of an induction motor is a function of the supply frequency and the number of poles of the motor winding. To obtain different speeds with a fixed supply frequency, the number of magnetic poles of the motor must be changed. Characteristics at any speed are similar to those of a single-speed motor. There are two basic methods for providing multiple combinations:

- **Separate-Winding Motors** have a separate winding for each speed. This motor construction is relatively simple, and a wide variety of speeds can be selected. Separate winding motors with delta connected motor windings require one corner to be opened on each unused winding.
- **Consequent-Pole Motors** have a single winding for two speeds. Extra winding taps are brought out for reconnection for different numbers of stator poles. The controller is more complicated, and speed range is limited to a 2-to-1 ratio.

Two-speed consequent-pole motors have one reconnectable winding. Three-speed motors have two windings, one of which is reconnectable. Four-speed motors have two reconnectable windings. Each unused delta connected winding must have one corner open.

Torque Characteristics

Multi-speed motors are divided into three application groups:

- **Constant Torque:** HP output varies directly with speed, while torque remains constant. A constant torque motor rated 100 HP at 1200 rpm delivers 50 HP at 600 rpm. This type is applicable to conveyors, mills, dough mixers, reciprocating pumps, and other similar loads.
- **Variable Torque:** HP varies as square of speed, while torque varies directly with speed. A variable-torque motor rated 100 HP at 1200 rpm delivers 25 HP at 600 rpm. This type is applicable to drives having fan or centrifugal pump characteristics.
- **Constant Horsepower:** Motor delivers rated HP at all full-load speeds, while torque varies inversely as speed. This type is applicable to cutting tools, lathes, spindles, etc.

Starter Types (NEMA Sizes 0–7)

Single Winding (Consequent Pole)
Variable Torque

Single Winding (Consequent Pole)
Constant Torque

Single Winding (Consequent Pole)
Constant Horsepower

Two Winding (Separate Winding)
Variable Torque

Two Winding (Separate Winding)
Constant Torque

Two Winding (Separate Winding)
Constant Horsepower

Note — Reversing types, reduced voltage types, and three or four speeds are also available.

Enclosures

Type 1: General Purpose

Type 3R: Outdoor Raintight

Type 12: Dusttight — Industrial Use

Type 4: Watertight Stainless Steel or Watertight Painted Sheet Steel

Ratings

Table 15.33 3-Phase Multi-Speed Starter

NEMA Starter Size	Half Size	Maximum Horsepower		
		200V	230V	460/575V
0		3	3	5
1		7.5	7.5	10
	1 ¼*	10	10	15
2		10	15	25
	2 ½*	15	20	30
3		25	30	50
	3 ½*	30	40	75
4		40	50	100

Dimensions

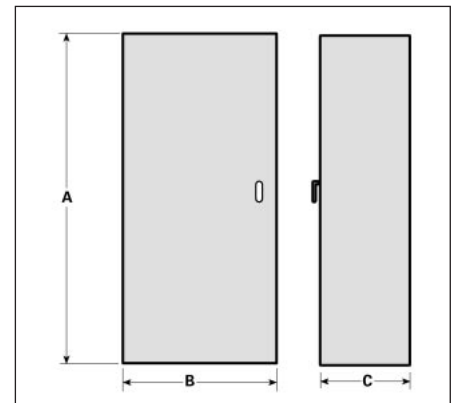


Table 15.34 Combination Multi-Speed Starter

	Size	Dimensions in Inches (mm)		
		A	B	C
NEMA 1 General Purpose Enclosures	0–1 ¼	25.75 (654)	16.00 (406)	7.63 (194)
	2–3	31.50 (800)	19.00 (483)	7.63 (194)
NEMA 12 Industrial Use Enclosures	0–1 ¼	28.50 (724)	16.00 (406)	7.69 (195)
	2–3	34.25 (870)	34.25 (870)	7.69 (195)

AC Controls

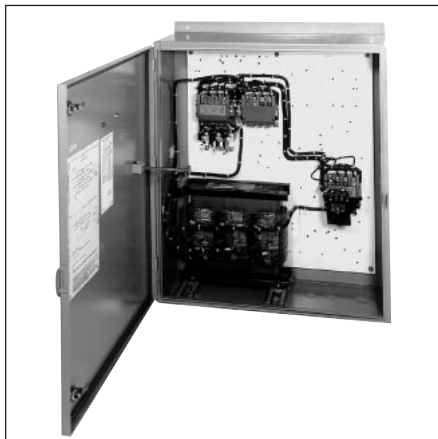
Reduced Voltage Starters — Electromechanical

General

Auto Transformer Starter

Operation

At starting, the auto transformer reduces motor terminal voltage to 50, 65, or 80 percent of line voltage. For a timed interval, a segment of the transformer coil is connected in series (as an inductor) with the motor. Then a contactor automatically connects the motor across the line and shorts out the inductor.

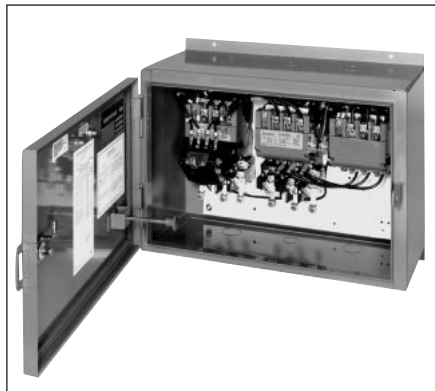


Auto Transformer Starter

Wye Delta Starter

Operation

Initially the starter connects the motor on a Wye connection, reducing voltage across the winding to approximately 58 percent. Starting torque and current is about 33 percent of across the line. After a time delay the motor is connected Delta.

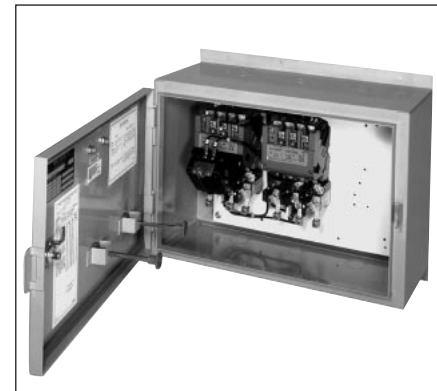


Wye Delta Starter

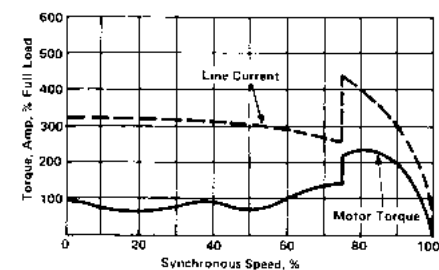
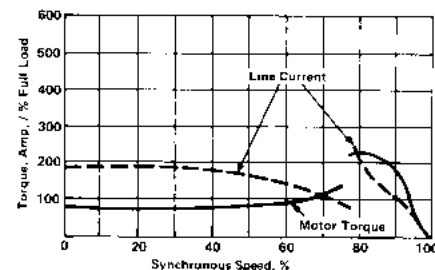
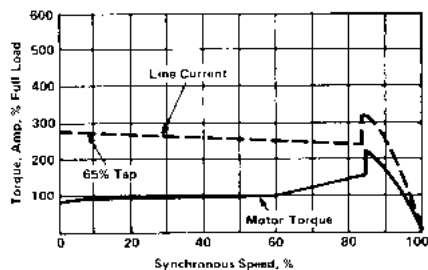
Part Winding Starter

Operation

Part winding starters apply starting current in timed steps to part winding motors. Two step controllers apply voltage through one starter to one motor winding followed by the second starter which connects voltage to the second winding. The timer may be adjusted to automatically close the second controller at the most favorable time to minimize voltage fluctuations.



Part Winding Starter



Typical Speed Torque Curves

Table 15.35 Comparison of Various Electromechanical Methods of Reduced Voltage Motor Starting

Characteristics	Reduced Voltage Starting				
	Autotransformer ^①			Part Winding 2 Step	Wye(Star) Delta
	50% Tap	65% Tap	80% Tap		
Starting current drawn from line as % of that which would be drawn upon full voltage starting ^②	25%	42%	64%	64% ^③	33%
Starting torque developed as % of that which would be developed on full voltage starting	Increased slightly with speed			45% ^③	33%
Smoothness of acceleration ^④	First in order of smoothness			Third in order of smoothness	Second in order of smoothness
Allowable accelerating times (typical)	30 seconds Based on NEMA medium duty transformers			2-3 seconds Limited by motor design	45-60 seconds Limited by motor design

^① Closed Transition.

^② Full voltage start usually draws between 500% and 700% of full load.

^③ Approximate values only. Exact values may be obtained from motor manufacturer.

^④ Solid state starters provide the smoothest starting characteristics.

AC Controls

Solid-State Reduced Voltage Starters



Class 70 / 71

Siemens-Furnas Class 70 / 71 combines Digital Signal Processor control and silicon controlled rectifier (SCR) technologies to provide optimum AC induction motor starting and operation. It provides soft start, energy savings,* soft stop,* and added protective features.

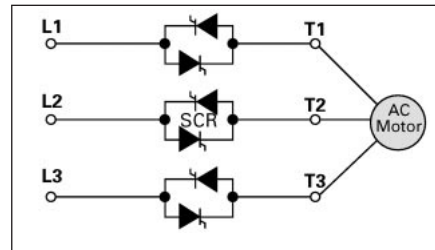
The basic controller consists of electronic circuit boards linked via flat cable connectors. The main functions of the basic assembly are to monitor the operating parameters of the controller and to control the firing sequence of the SCR's. The power module located below the basic controller controls power to the motor. The incoming and motor load connections are made to terminal blocks located on the top and bottom of the power module.

The starters are available either as NEMA Type 1, 12, or 4 enclosures. Units are supplied with solid-state overload relays as complete starters, or as combination starters with fusible, non-fusible disconnect, or thermal magnetic circuit breakers with or without shunt trip features. Additional options are also available.

The Class 70 / 71 is designed to operate 3 phase AC induction motors at 208 to 575 volts and 6.1 to 960 amperes at 50 or 60 Hertz.

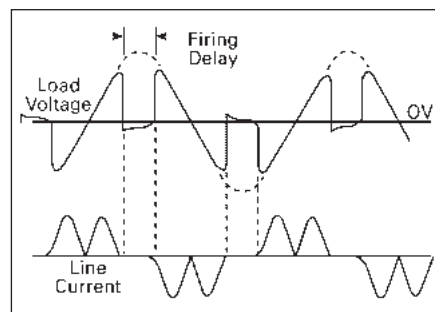
Operation

The solid state motor controller uses silicon controlled rectifiers (SCR's) to control the voltage to the motor windings. Each SCR acts as a switch that can be turned on with any electronic trigger signal at any point on the voltage waveform and turns off when the current waveform crosses zero. Two SCR's are used in a back-to-back arrangement in each phase to allow alternating current to pass to the motor.



3-Phase Control Configuration

When SCR triggering is delayed, the voltage to the load is reduced. This phase-controlled operation provides soft starting with stepless acceleration. Once the motor is running, voltage reduction can improve the motor's operating point at partial load, saving energy and lowering the reactive current.



3RW2 Phase Control

Shorted SCR^①

If one or more shorted SCRs are detected, the starter will not energize. A fault LED will light and if provided with a shunt trip, the main circuit breaker will trip.

Pump Stop^①

This option eliminates water hammer in pumping systems, by giving a controlled decel to the motor voltage. This process allows for smooth pressure reduction and quiet check valve operation.

Phase Loss

The controller will trip off the line if one or more phases is lost.

^① Available on 2000+ Starter

AC Controls

Solid-State Reduced Voltage Starters

Dimensions

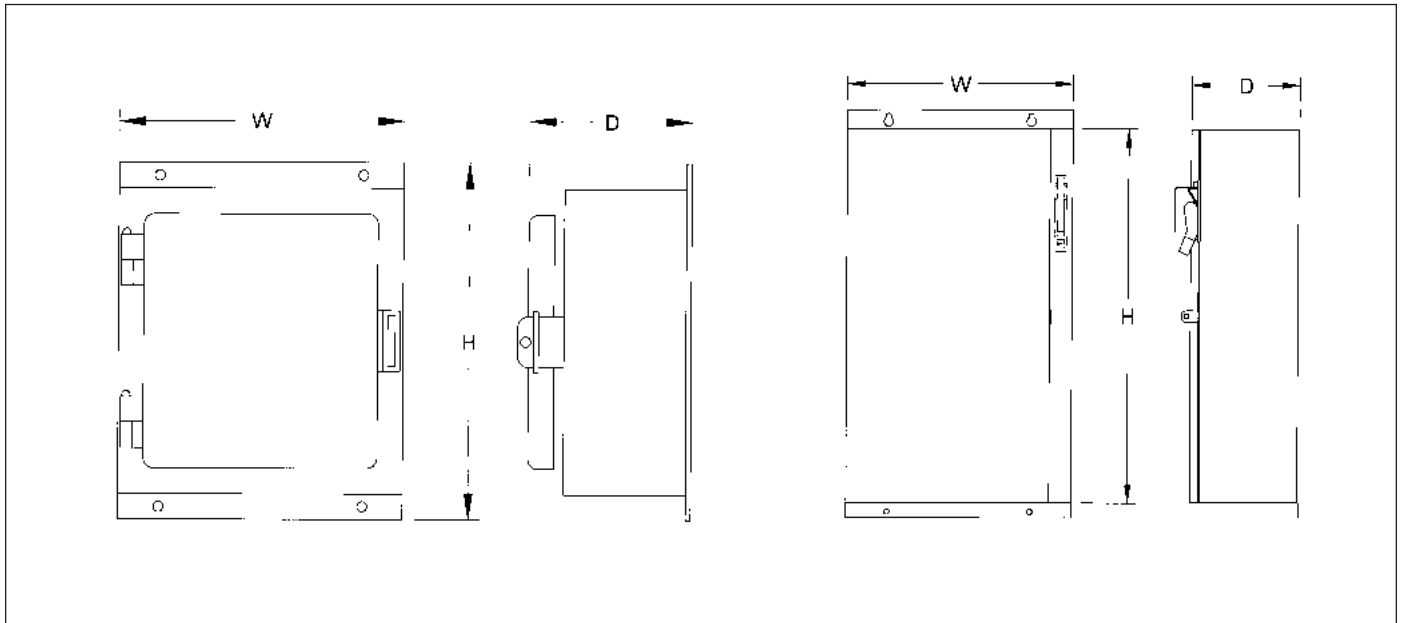


Table 15.36 Solid-State Reduced Voltage Starters

Current Rating Amps	Dimensions In Inches (mm)					
	Height	Width	Depth	Height	Width	Depth
Class 70	NEMA 1, 12					
6.1–22	15 (381)	14 (356)	10 (254)	—	—	—
42–55	25 (635)	18 (457)	13 (330)	—	—	—
68–192	36 (914)	23 (584)	10 (254)	—	—	—
248	53 (1346)	23 (584)	10 (254)	—	—	—
361–480	54 (1372)	36 (914)	11 (279)	—	—	—
720	91 (2311)	30 (762)	15 (381)	—	—	—
Class 71 MCP or Thermal Mag	NEMA 1			NEMA 12		
6.1–22	26 (660)	16 (406)	13 (330)	26 (660)	16 (406)	13 (330)
42–55	36 (914)	20 (508)	11 (279)	36 (914)	20 (508)	11 (279)
68–105	46 (1168)	20 (508)	10 (254)	46 (1168)	20 (508)	10 (254)
130	53 (1346)	25 (635)	10 (254)	46 (1168)	20 (508)	10 (254)
192–248	76 (1930)	22 (559)	13 (330)	76 (1930)	22 (559)	13 (330)
361	90 (2286)	20 (508)	15 (381)	90 (2286)	30 (762)	15 (381)
480	90 (2286)	30 (762)	15 (381)	90 (2286)	30 (762)	15 (381)
720	90 (2286)	40 (1016)	15 (381)	90 (2286)	50 (1270)	15 (381)
Class 71 Fusible Disconnect	NEMA 1			NEMA 12		
6.1–22	26 (660)	16 (406)	13 (330)	26 (660)	16 (406)	13 (330)
42–55	36 (914)	20 (508)	11 (279)	36 (914)	20 (508)	11 (279)
68–105	46 (1168)	20 (508)	10 (254)	46 (1168)	20 (508)	10 (254)
130	53 (1346)	25 (635)	10 (254)	53 (1346)	25 (635)	10 (254)
192–248	90 (2286)	20 (508)	15 (381)	90 (2286)	20 (508)	15 (381)
361	90 (2286)	30 (762)	15 (381)	90 (2286)	30 (762)	15 (381)
480	90 (2286)	40 (1016)	15 (381)	90 (2286)	40 (1016)	15 (381)
720	90 (2286)	50 (1270)	15 (381)	90 (2286)	50 (1270)	15 (381)

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AC Controls

AC Controls

Pilot Device Units

Pilot Device Units and Indicator Lights — Type 3SBO

Pilot Device Options

3SBO pilot devices are built by Siemens in two basic forms - 1) as assembled for the most frequently used configurations, or 2) as subassemblies for greater flexibility.

Application

3SBO devices are heavy duty oiltight, watertight, and dusttight (NEMA Type 4, 4X, 13, IP65). They are used in industrial control circuits at 600V or less. 3SBO pilot devices are available in two diameters, 7/8" and 1-13/64" (22 and 30 mm).

7/8" (22 mm) Mounting

The operator is inserted into the hole in the panel from the front and twisted into the contact block holder. The unit is then fixed from behind by means of two set screws which are located in the contact block holder, preventing the unit from working loose or twisting.

1-13/64" (30 mm) Mounting

The holder is an integral part of the actuator, it is inserted into the hole in the panel from the rear and secured from the front by means of a front ring. With the use of a legend plate or the thrust and trim washers, the unit becomes stationary and will not twist or work loose.

Front Rings

Both units are supplied as standard with metal chrome plated front rings. Black plastic or anodized aluminum rings are optional at no additional cost. The plastic rings are recommended for use where the atmosphere may be corrosive.

LED Indicating Lights (Optional)

Since LED's consume less power, their life is 10 to 20 times that of conventional incandescent lamps. They also provide greater resistance to shock and vibration. Where lamp integrity and low maintenance is crucial, the 3SBO LED indicator is recommended.

Contact Blocks

One line of contact blocks fits both size devices. All have parallel double break contacts with wiping action and reliability nibs to insure long, maintenance-free

operation. The design is also well suited to low energy circuits common on programmable controller interfaces. Blocks snap side by side on the holder and lock in place. The contact block holder is available in 3 and 5 position versions, eliminating the need for piggyback contacts which are hard to wire and prone to failure. Terminals meet the "touchsafe" requirements of IEC standards and are clearly marked.

Wire funnels, screwdriver guides, and captive terminal screws make the contacts easy to wire while self lifting spring washers insure that the wire stays secure under severe vibration.

Special contact blocks are available for solder connection to printed circuit boards. When used with the special operator adaptor, they present a unique solution to multiple button operator panels.



Pushbutton Unit
7/8" (22 mm) Mounting



Pushbutton Unit
1-13/64" (30 mm) Mounting

AC Controls

Enclosed Pilot Device Stations

General

Enclosed Pilot Device Stations

P22 Series

P22 stations are NEMA Type 1 metal enclosures and are available in 1, 2, 3, 4, and 6 hole enclosures. Completely assembled stations are standard up to 3 hole units. Empty enclosures are available for 7/8" (22 mm) pilot devices, up to six units.

PBS1 Series

Flush mounted NEMA Type 1B stainless steel plate are available with one and two device configurations.

3SBO2 Series

3SBO2 pushbutton stations use 7/8" (22 mm) pilot devices. Contact blocks are base mounted in the enclosure to permit easy wiring and service. The stations are available either assembled or unassembled. Special stations can be ordered complete from the factory. 3SBO2 pilot device stations are rated NEMA 1, 3R, 4, 4X, 13, and IP65. Empty enclosures are available in molded plastic and cast aluminum, and are supplied with conduit adapter, contact mounting plate, and sealing ring.

P30 Series

P30 pilot device stations use 1-13/64" (30 mm) pilot devices and are available in a number of configurations to meet most applications. The stations are available either assembled or unassembled. P30 series stations are available in NEMA 1, 3R, 4, 4X, and 13 enclosures.

Application

Class 52 oil tight pilot controls and accessories are designed to provide long, trouble free service in the most demanding industrial applications. These controls are oil and dust tight and meet NEMA 1, 3, 4, 12, and 13 specifications.

Push Button Operators

The operator base consists of a durable, one piece casting equipped with a heavy duty acrylic actuator with a stainless steel spring, a neoprene actuator sealing ring to prevent oil and dust from penetrating to the contact blocks, a neoprene gasket to seal operator mounting hole, and a chrome plated lock nut.

Contact Blocks

Contact blocks have double break bifurcated silver contacts which improve contact fidelity. Contact blocks are heavy duty rated NEMA A600 and suitable for applications with low current draw. Molded bodies and pushers resist arcing and tracking. All units have stainless steel springs that resist corrosion and provide strong contact pressure. Captive mounting screws speed panel assembly.



P22 Series NEMA 1



PBS1 Series



3SBO2 Series



P30 Series NEMA 4X

3-Phase Manual Starters and 1-Phase Starters

All 3-Phase manual starters and single-phase starters rated above 1 HP shall be Siemens Class 11. They shall meet or exceed the requirements of NEMA, UL, and CSA. The starter must feature quick-make and quick-break contact operation and cannot be teased into open condition. It shall be provided with Class 20 melting alloy overload protection, have optional low voltage protection, padlock capability, and be available in open, NEMA 1, 3, 4, 7 & 9, and 12 enclosures. Operating mechanism must clearly show their position whether unit is on, off, or tripped.

Combination Starters, NEMA Size 0–5

Across-the-line non-reversing or reversing combination starters for motors up to 200 HP, 460 volts shall be Type SCB (motor circuit interrupter Type ETI), Type SCF (fusible disconnect switch Type MCS), or Type SCN (non-fusible disconnect switch, Type MCS). They shall be built in accordance with the latest NEMA ICS2 standards and shall be UL Listed.

The Type SCB and SCF shall be UL Listed for applications requiring up to 100,000 amps withstand ratings without the addition of current limiters. Class "R" fuse clips to be supplied as standard.

Starters shall be equipped with three pole double break contactor with arc quenching system consisting of arc chutes with arc splitter plates and a maximum contact bounce time of 2 milliseconds for extended contact life. The contactor shall have a minimum locked rotor rating of 840% FLA for 10 seconds duration. Starter shall include a minimum of two normally open and two normally closed contacts as standard (one open and one closed on reversers).

Starters shall be equipped with three-pole overload relays. Overload relay shall be block-type NEMA Class 20 with a test feature. An isolated field mountable alarm contact should be available. An optional Class 10 overload relay should also be available for factory or field installation.

The combination starter operating handle shall always remain connected to the breaker or switch. The operating handle shall not be mounted in the door of the enclosure, but to the side of the door in the enclosure flange for safe "stand aside" operation. Position of operating handle will indicate "on, off, or tripped" condition of switch or circuit breaker.

Interlock provisions shall prevent unauthorized opening or closing of the starter door with the disconnect in the "on" position. Operating handle shall be suitable for padlocking in the "off" position.

Type SXL and SRL Non-Reversing or Reversing Starters

Across-the-line magnetic starters for motors up to 200 HP, 600 volts, shall be Siemens Class 14 starters or equal. They shall be built and tested in accordance with the latest NEMA Standard ICS2-321 and UL Listed.

Starters shall be equipped with three-pole, double-break contactors 45° wedge action cross arm design utilized to minimize arcing contact bounce. Half-sized for specific HP ratings between NEMA sizes should be available for space and cost savings. Coils should snap in and out for ease of inspection and changing. Dual voltage coils shall be optional. Starter shall include one normally open auxiliary contact as standard with capability of mounting at least 3 additional.

Starters shall be equipped with three-pole overload relays. Overload relay shall be melting alloy-type NEMA Class 20 with a test feature. An isolated field mountable alarm contact should be available. Optional Class 10 overload relay should also be available for factory or field installation.

Full Voltage Starters, NEMA Size 6–8

Across-the-line reversing and non-reversing starters for motors rated above 100 HP at 230 volts, and above 200 HP at 460 volts. Starters shall be equipped with three-pole double-break contactors with an arc quenching system consisting of arc chutes with arc splitter plates and a limited contact bounce to extended contact life. Starter shall include a control transformer as standard. Starter shall also include a solid state microprocessor controlled overload relay with three current transformers and shall have an adjustable tripping class from Class 10 to Class 30 to compensate for long acceleration times. The overload relay shall offer protection from overloads, phase loss, and phase unbalance, and also include an isolated alarm circuit contact and test button. The starters shall be built and tested in accordance with the latest NEMA standard ICS 2-321 and UL Listed.

All starter enclosure types are fabricated types, in accordance with the latest

NEMA standards. All operating parts can be removed quickly and easily from the front.

Devices shall have straight through wiring and conveniently located connection points for external wires and cables minimize installation time. Combination starters shall be of either the fusible switch, non-fusible switch, or molded case circuit breaker type. Combination fusible starters shall contain fuse clips for Class L current limiting fuses rated 200,000 amps symmetrical interrupting capacity, and shall have an externally operated load break disconnect switch. On the combination circuit breaker version, a molded case thermal magnetic circuit breaker which has an adjustable magnetic trip provision, shall be provided.

Reversing starters will contain two contactors that are electrically and mechanically interlocked in addition to all the above described features. 3-phase, 250 to 900 HP non-reversing and reversing 50 / 60 Hz. NEMA size 6 through 8 full-voltage starters are used for across-the-line starting of squirrel cage induction motors and the primary control functions for wound rotor motors. In addition they can be used for control of power for static or resistive loads such as lighting and heating. They provide the lowest cost, least maintenance and minimum space requirements of any magnetic starters where inrush current limitations do not restrict their use.

Starter Types

Non-Reversing

Class 18 Motor Circuit Interrupter (ETI)

Class 17 Fusible Switch (MCS)

Class 17 Non-Fusible Switch (MCS)

Reversing

Class 26 Motor Circuit Interrupter (ETI)

Class 25 Fusible Switch (MCS)

Class 27 Non-Fusible Switch (MCS)

Additional Starter Sizes

Oversize enclosures are available: Class 17 and 18, NEMA sizes 0–4.

Reduced Voltage Autotransformer Starters

Reduced voltage starters shall be Siemens Type SAT for motors up to 900 HP, 600V. Starter shall be the closed transition type providing field adjustable voltage taps for 50, 65, and 80% of the line voltage. The autotransformer shall be a NEMA medium duty with internal thermal protectors for protection of overheating due to excessive repeat starts that exceed the allowable number of starts on the transformer. Incomplete sequence protection is to be provided on all NEMA size 6–8 starters.

Autotransformer starters shall be equipped with three-pole double-break contactors with an arc quenching system consisting of arc chutes with arc splitter plates and a maximum 2 millisecond bounce time on sizes 2–5 to extend contact life. Run contactor shall be capable of carrying a minimum of 840% full-load current for 10 seconds duration on sizes 2–5. Starter shall include two three-pole contactors, to connect the autotransformer for reduced voltage starting, and a two-pole (run) contactor to bypass the autotransformer and connect the motor for full voltage across-the-line running after a predetermined starting time is reached. A transition timer shall be provided which can be field adjusted to set the starting time. Starters shall be equipped with three-pole overload relays. Overload relay shall be a block type NEMA Class 10 with push to test feature, phase unbalance and phase loss protection, be field adjustable, and have an isolated alarm circuit contact. For NEMA Size 6–8 starters, the overload relay shall be a 3UB solid state microprocessor controlled device and have a field adjustable class setting from Class 10 through Class 30 to compensate for long accelerating times.

The starters shall be built and tested in accordance with the latest NEMA standard ICS 2-321 and UL Listed.

Multi-Speed Starters

Type S1, S2 multi-speed starters shall be equipped with three-pole, double-break contactors with an arc quenching system consisting of arc chutes with arc splitter plates, and a maximum 2-millisecond bounce time on sizes 2–5 to extend contact life.

Starters shall be equipped with three-pole overload relays. Overload relay shall be a block type NEMA Class 10 with push-to-test feature, phase unbalance and phase loss protection, be field adjustable, and have an isolated alarm circuit contact. For NEMA Size 6–8 starters, the overload

relay shall be a 3UB solid state microprocessor-controlled device and have a field adjustable class setting from Class 10 through Class 30 to compensate for long accelerating times. The starters shall be built and tested in accordance with the latest NEMA standard ICS 2-321 and UL Listed.

Reduced Voltage Wye Delta Starters

Wye Delta Open And Closed Transition Starters

Wye delta starters shall be equipped with three-pole double-break contactors with an arc quenching system consisting of arc chutes with arc splitter plates and a maximum 2-millisecond bounce time on sizes 2–5 to extend contact life. Starter shall include three 3-pole contactors sized per NEMA standard ICS-2-321-7 and appropriate mechanical interlock.

A transition timer shall be provided which can be field adjusted to set the starting time. A fourth contactor will be used on closed transition starters with transition resistors wired in each phase. An incomplete sequence relay shall be included to protect the transition resistors in the event the transition is not completed.

Wye delta starters shall be equipped with a three-pole overload relay wired in the phase windings.

Overload relay shall be a block type NEMA Class 10 with push to test feature, phase unbalance and phase loss protection, be field adjustable, and have an isolated alarm circuit contact. For NEMA size 6–8 starters, the overload relay shall be a 3UB solid state microprocessor controlled device and have a field adjustable class setting from Class 10 through Class 30 to compensate for long accelerating times. The starters shall be built and tested in accordance with the latest NEMA Standard ICS 2-321 and UL Listed.

Reduced Voltage, Part Winding Starters

Part Winding Starters

Part winding starters shall be equipped with three pole double break contactors with an arc quenching system consisting of arc chutes with arc splitter plates and a maximum 2-millisecond bounce time on sizes 2–5 to extend contact life. Starter shall include two three-pole contactors mechanically interlocked. A transition timer shall be provided which can be field adjusted to set the starting time. Starters shall be equipped with three-pole overload relays. Overload relays shall be a block type NEMA Class 10 with push-to-test

feature, phase unbalance and phase loss protection, be field adjustable, and have an isolated alarm circuit contact. For NEMA size 6–8 starters, the overload relay shall be a 3UB solid state microprocessor controlled device and have a field adjustable class setting from Class 10 through Class 30 to compensate for long accelerating times. The starters shall be built and tested in accordance with the latest NEMA Standard ICS 2-321 and UL Listed.

Solid State Reduced Voltage Starters Voltage Limit:

To set a soft start, no need to know full load amps regardless of motor size (it limits inrush current during the starting period). It reduces peak torques at near synchronous speed compared to current limit start.

Impulse Start: Provides breakaway torque for high friction loads such as crushers or mixers, it reduces motor heating compared to ramp starts.

Shunt Trip: For positive isolation on fault conditions; in case of 2 shorted SCR'S.

Emergency Start: With a shorted SCR, controller should be able to soft start and run to save the process.

Under / Over Voltage: Under over voltage protection prevents motor and controller damage.

UL Ratings: UL Listed and short circuit tested for 65 kA or higher with circuit breakers (magnetic trip only breakers). Short circuit tested for 100 kA with RK5 fuses.

Diagnostics: On board fault diagnostics with selectable fault relay output.

Initialization Check: 50-millisecond check on start; for short circuit, power line conditions, and load connections.

Re-Start of Rotating Motors (Start on the Fly): Starting motors with applied BEMF (back electro magnetic force) with no transients. No need to wait for field to collapse or decay. Smooth reversing.

Power Outage: Ride-through power outages for 0.5 seconds on control power up to 5 seconds on primary power.

SCR Thermal Protection: Temperature and current predicting model to protect SCR's for all conditions by keeping semiconductors below the rated junction temperature.

Fully Isolated Electronics: All inputs, relays and DC power components must be isolated from customer connections to provide noise immunity, 2500 volt dielectric with start.

Inputs: All inputs must operate on 120 volts including remote reset input.

Communications: Communications port must be provided on the electronics to interface with IBM compatible PC via RS232 link.